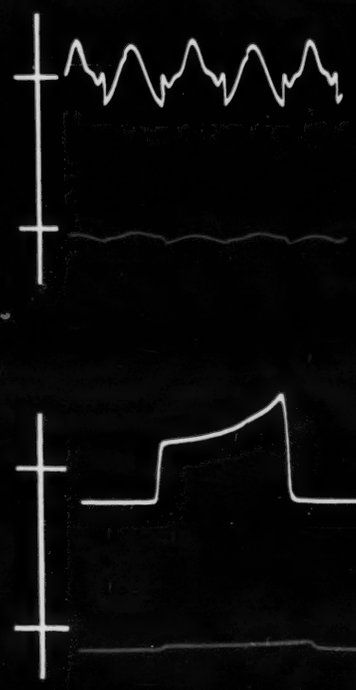
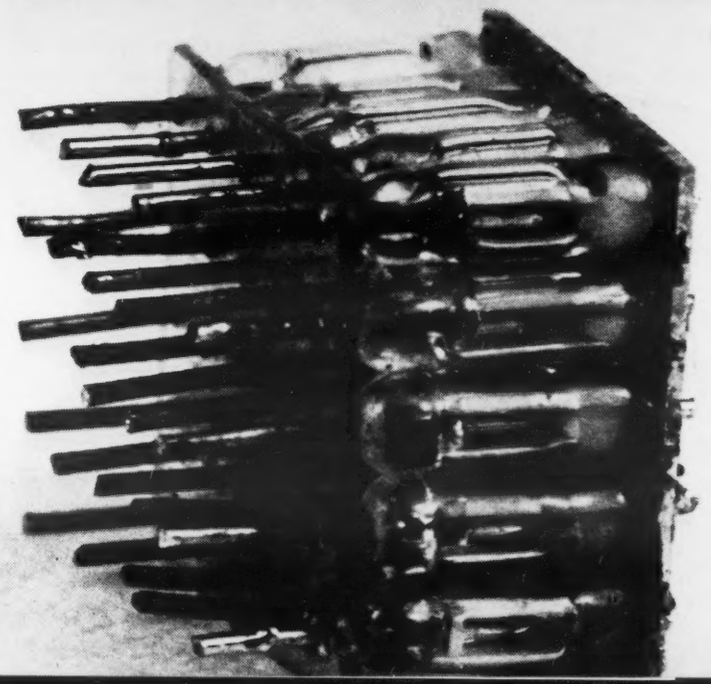
ELECTRONIC design





TWENTY-FIVE new type subminiature high-output diodes can be mounted on a 1/4 sq in plate. Upper curves compare two conventional with two new diodes as to null voltage outputs in a balanced bridge rectifier circuit. Flatness of the red curve indicates extreme uniformity of the new units. Lower curves compare forward drop with a 100ma, one microsecond pulse applied.

September 1954

Staff

Edward E. Grazda ..... Editor
M. Mandell ..... Associate Editor
M. J. Friday ..... Assistant Editor
R. Graham ..... Assistant Editor
P. L. Canfield ..... Editorial Assistant
N. Asto ..... Production Manager
E. Dadinos ..... Assistant Production Manager
H. W. Schlager ..... Business Manager
J. B. Gilchrist ..... Circulation Manager

Co-Publishers

T. Richard Gascoigne
James S. Mulholland, Jr.

Advertising Representatives

New York: T. Richard Gascoigne, James S. Mulholland, Jr., Blair McClenachan, 127 East 55th St., New York 22, N. Y., PLaza 3-8677

Chicago: Thomas P. Kavooras, 664 No. Michigan Ave., Chicago 11, Ill., SUperior 7-8054

Los Angeles: Robert E. Ahrensdorf, 1140 Wilshire Blvd., Los Angeles 17, Calif., MAdison 9-2681

Circulation Policy

ELECTRONIC DESIGN is circulated only to qualified electronic design engineers of U. S. manufacturing companies, industrial consultants, and government agencies.

If design for manufacturing is your responsibility, you qualify for a subscription without charge provided you send us the following information on your company letterhead: your name and title; your company's name, address, and main product. Electronic, research, development, project, electrical, and chief engineer are typical qualifying titles.

If you have a design responsibility not indicated by your title, add a description of those responsibilities.

Any job change requires requalification.

Hayden Publishing Company, Inc.
127 East 55th Street
New York 22, New York

Back issues of ELECTRONIC DESIGN, when available, may be obtained at a charge of $1.00 per copy.

ELECTRONIC design

Vol. 2
No. 9
September 1954

Contents

BPA NBP

ELECTRONIC DESIGN is published monthly by Hayden Publishing Company, Inc. at 127 E. 55th Street, New York 22, N. Y., T. Richard Gascoigne, President; James S. Mulholland, Jr., Vice-President & Treasurer; and Ralph E. Marson, Secretary. Printed at Publishers Printing Company, New York, N. Y., ELECTRONIC DESIGN is circulated monthly without charge to men in the electronic industries who are responsible for the design and specification of manufactured devices, including development and design men of consulting laboratories and government agencies. Acceptance under section 34.64 P. L. & R. authorized.

24,000 copies this issue.

Editorial . . .

The Quiet Revolution

For some time now, a slow steady change has been taking place in electronic devices as a result of two relatively recent developments in the field. One of these is a component and the other a production technique. Both are so basic that their adoption is causing a "quiet revolution" in the electronic industries. We are, of course, referring to the transistor and the use of printed circuit techniques.

Of these two developments, the transistor has produced the lesser impact as far as commercial applications are concerned. Cost, availability, limited frequency range, and lack of standardization are some of the reasons why many designers have been reluctant to use transistors. Through intensive research and development programs on the part of transistor manufacturers, all of these deterring factors are rapidly being corrected. Before too long we should see many new commercial applications of transistors on the market.

Printed circuit techniques, on the other hand, have gained a fair amount of acceptance among designers. Test instruments, small phonograph amplifiers, larger audio amplifiers, a-m/f-m receivers, computers, and TV receivers are some of the places where printed circuit techniques are being employed. One TV set manufacturer has designed his set using sectionalized printed circuits throughout, and a French TV receiver has been publicized that has the entire chassis printed on a single sheet of laminate material. All kinds of interesting schemes are being tried. The next several issues of ELECTRONIC DESIGN will cover some of these design ideas in detail.

This revolution, though quiet in the sense that not much publicity has been given the commercial applications of these developments, is none the less real. It is up to the designer to make his company aware of this trend and to lead management out of its interior by thoroughly investigating the possibilities of these developments for his particular product line.

Engineering Review . . .

TV of the Future . . . The television receiver of 1964 is envisioned as having a picture screen so thin that the complete unit could be hung on the living room wall like a painting. The circuitry would be built into the picture frame and would use printed wiring and miniaturized components. Controls would be located in a small box besides the viewer's chair.

For those who might prefer a table model, the thin picture screen would be mounted, like a vanity mirror, attached to slender arms extending upright from a small cabinet that would house the circuitry.

As explained by Dr. Lloyd T. DeVore, manager of the General Electric Company's Electronics Laboratory, the "picture on the wall" concept stems from a complex project to speed the plotting of aircraft in military filter centers. At present, this aircraft plotting is done manually. Plotting would be automatic with a thin-type screen. Development of speedier switching techniques and new fast-reacting phosphors are needed before the thin-type screen can be applied to TV sets.

Scientist Honored . . . For his invention of the zirconium concentrated-arc lamp, Mr. William D. Buckingham of the Western Union Telegraph Company has been awarded a John Price Wetherill Medal by the Franklin Institute, Philadelphia 3, Pa. The device produces a high-intensity, sharply defined, extremely small beam of light with moduation characteristics unobtainable at the time of its invention.

Compact Airborne Radar . . . A new airborne radar that can spot storms up to 150 miles ahead is being installed on Pan American-Grace Airways' new fleet of Douglas DC-7's. Designated the Type RDR-1, the equipment operates in the X-band (3.2cm).

Manufactured by Bendix Radio Div., Bendix Aviation Corp., Baltimore 4, Md., the design of the radar is based on this firm's military weather radar. The five-unit system weighs 136-1/2 lb. Power output for a pulse width of 2.0μsec is 40kw peak. The repetition rate is 400pps. Beamwidth is 3.8°.

Sweep ranges available on the point position indicator are 0-20, 0-50, and 0-150 miles, with range marks at 5, 10, and 25 miles. The nose-mounted 22″ diam antenna is gyro-stabilized. While designed primarily for weather purposes and as a storm-warning device, the radar has provisions for ground beacon navigation and terrain radar mapping.

Tri-Element Atomic Battery . . . By adding a third element to an atomic battery, the Ohmart Corporation has produced a cell in which a varying signal applied to this control element results in a variation in current output of the cell. Acting very much like the grid of a vacuum tube, the added element converts the battery into a self-powered amplifier with wide application possibilities. A photograph of the unit and cross-section are shown below.

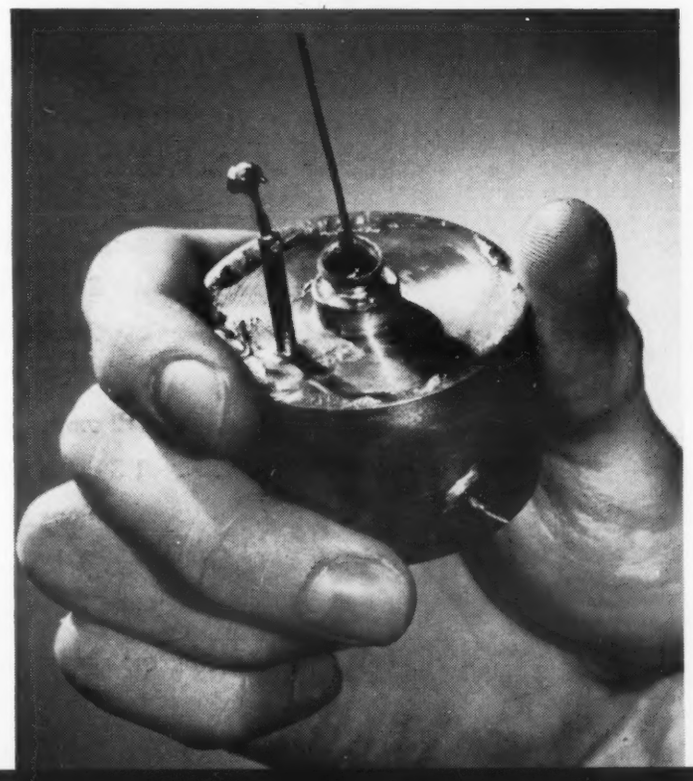
The radioactive source is strontium-90, a long-life isotope. Although it is a waste product of atomic reactors, this atom source is very expensive at present. It is also employed in this firm's two-element atomic battery. The efficiency of utilization of the isotope is not very high and should be increased with further development.

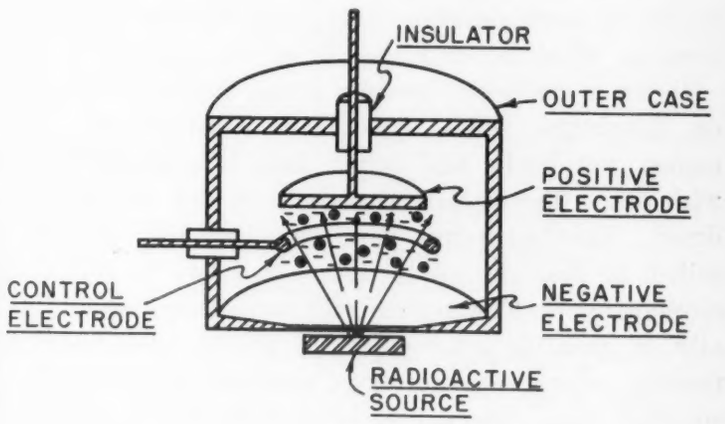
In the first version of the tri-element type, the control element is in the form of a metallic ring and the enclosure is filled with argon gas as a separating medium. With a load resistor of 10^{11} ohms, the amplification factor is 0.075 within the range of control element potential of −12 to zero volts and 0.28 when the potential is +2 to +10v. Argon is a more suitable separating medium than air, which has also been tested.

The amplification factor can be increased by making the control element in the form of a grid instead of a ring and by increasing the density of the separating medium. A semi-conductor could serve as the required separating medium.

The Ohmart Corporation, located at 2236 Bogen St., Cincinnati 14, Ohio, has developed some applications for the device. One, in which the cell serves as a transducer to match a low impedance to a high impedance, is in a small, all-electronic integrating device. The firm's two-element battery, which has an adjustable output, has already been widely applied in industry to furnish constant currents for reference purposes. One application is in a density gage for pipe lines to determine what fluid is flowing in the line. This gage is manufactured by Ohmart. The battery can also be used as a standard cell.

The tri-element atomic battery shown below can act as a self-powered amplifier. A cutaway diagram of the battery is given at the right.





Radio Research Laboratory . . . A new multimillion dollar radio research laboratory is being established at Boulder, Colo. by the National Bureau of Standards, Washington 25, D. C. The NBS already maintains a number of transmitting antennas for research purposes in the same area.

The laboratory will continue efforts for more effective utilization of the available spectrum and compile information about the characteristics of radio energy under diverse conditions.

Engineering Review . . .

Millionth Transistor . . . Raytheon Manufacturing Company has produced its one-millionth transistor. The great majority of the firm's output has gone into hearing aids, where field failures are running at the low rate of less than 2% per year. This compares with a failure rate of about 2% for subminiature tubes in the same service. The transistors were produced at Raytheon's Receiving Tube Div., 55 Chapel St., Newton 58, Mass.

Electronic Air Traffic Control . . . The latest development in air-ground communications receives messages on flight plans and the weather, answers them within minutes where necessary, and stores the information for future use—all without human intervention. Known as the "Message Storage and Processing System", it was recently installed at the Civil Aeronautics Authority Technical Development and Evaluation Center at Indianapolis, Indiana.

Developed by the Engineering Research Associates Div., Remington-Rand, Inc., 315 Fourth Ave., New York 10, N. Y., it is estimated that 12 to 15 such installations can service all the major aircraft traffic centers in the nation. The system automatically receives coded messages from several remote points by teletypewriters, examines these messages and performs clerical operations on them, files up to 2000 such messages on a magnetic drum reference, locates any desired message and causes it to be typed out at one or more remote points, and discards any message when notified that it is not needed.

Using a magnetic memory drum, information on departure times, fuel loads, destinations, routes, pay-loads, and other data is compared with other flight plans already recorded on the drum. Existing plans are then revised, cancelled, or brought up to date, according to the circumstances. The system will warn automatically of possible emergency situations when a position report has not been received within a specified time interval after a flight has been estimated over a fix.

Electronic Farming . . . In order to harvest crops at the optimum time, two-way radios are being employed by a large food processor to direct harvesting equipment. The system is applied to the harvesting of such delicate crops as beans and peas, which reach and remain at peak quality for only a few hours.

Gibbs Foods of Quarryville, Pa., has four vehicles equipped with communication gear supplied by Radio Division, Bendix Aviation Corp., Baltimore, Md.

Instruments for Rent . . . Small electronic manufacturers can now utilize expensive electronic instruments for laboratory or production use by renting them. Polarad Electronic Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y., will rent valuable instruments at a monthly rental that is only a small fraction of their price.

The plan is particularly useful when some instrument is only required for a short time. A purchase option is available with the rental plan. Under the separate option contract, most of the rental charge may be applied towards eventual purchase.

Computer Clinic . . . An Electronic Computer Clinic will be held in conjunction with the First International Automation Exposition at the 244th Regiment Armory, 14th St., New York City, from November 30 to December 2, 1954. The clinic is a lecture and demonstration course on both digital and analog computers.

The course is planned for personnel who contemplate using computers in the laboratory or plant. Advance registration is required. Attendance at the sessions will be restricted in size. Sessions will be repeated up to a maximum of nine times to accommodate registrants. The registration fee is $5.00, payable in advance. Registration forms may be obtained from Richard Rimbach, Electronic Computer Clinic, 845 Ridge Ave., Pittsburgh 12, Pa.

Eight-Hour Magnetic Tapes . . . Magnetic recording tapes that run continuously for eight hours are now being offered to provide music in stores, factories, etc. The tapes are manufactured by Magne-Tronics, Inc., 122 E. 42nd St., New York 17, N. Y.

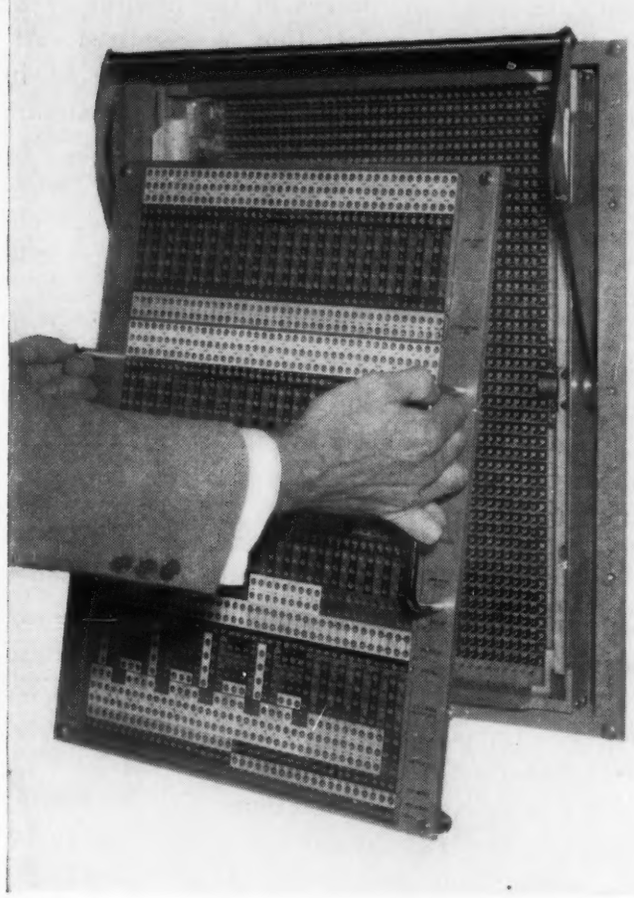
Antenna Rating System . . . A new antenna rating system known as the "Signal-to-Noise Figure of Merit Rating" has been proposed by Douglas Carpenter, Chief Antenna Engineer, JFD Manufacturing Company.

Five basic antenna functions, (1) horizontal polar pattern, (2) front-to-back and side ratio, (3) terminating impedance, (4) gain, and (5) vertical polar pattern, were selected to be considered in composite form to create the specific value designated "Signal-to-Noise Figure of Merit Rating". For each characteristic, an optimum level was established. A theoretically perfect antenna would be rated 100%, made up of a maximum of 20% for each of the factors.

A six-page brochure entitled "Signal-to-Noise Figure of Merit", is available from JFD Manufacturing Co., Form No. 287, 6101-16th Ave., Brooklyn 4, N. Y. It is complete with diagrams, charts, and an actual example of how this system can be applied.

Taping "Gun"

Electrical harness wrapping is greatly accelerated by using this new "taping gun" to dispense plastic tape. Weighing less than 20 oz with a 36-yard roll of 3/8" tape in the circular magazine, the gun enables an operator to bundle the wires and cut the tape in about one second. Once the tape is threaded around the bundle by the curved tip, it is cut by pressing a thumb button. This tool is marketed by Minnesota Mining and Manufacturing Co., St. Paul, Minn.



Patch Panel

A removable patch panel for the analog computer at the Analog Computation Center operated by Electronic Associates, Inc., near Princeton, N. J. The Center's facilities are available to industry on a rental basis. Problems can be set up on this panel at the Center or at the client's laboratory while the computer is working on other problems.

Engineering Review . . .

Transatlantic Data Processing . . . Statistical information has been transferred from one puched card to another across the Atlantic Ocean in a recent demonstration. The data was transmitted at the rate of 1000 characters a minute by radio.

The two-way experimental transmission was undertaken by the U. S. Air Force. It linked Port Lyautey, Morocco, and Washington, D. C. The punched cards were fed into a "data transceiver", a new machine developed by International Business Machines Corp., 590 Madison Ave., New York 22, N. Y., which converted the data into electrical signals.

If adopted, the system would eliminate steps in accounting procedures dealing with the deployment of military forces and the distribution of replacement equipment now maintained at Air Force bases. It would materially contribute to the speeding of procedures necessary to move replacement parts to overseas bases.

High-Fidelity Sales Premium . . . High fidelity components installed as original equipment in a home like a refrigerator are being used as a sales stimulant by a Dayton, Ohio contractor now developing a suburban residential area. In the model home, the sound equipment is installed in two mahogany panels that flank the fireplace. Behind one panel is the dual coaxial speaker and its enclosure. The amplifier, preamplifier, and record changer are located behind the opposite panel. Both panels are set flush in the wall at waist level. The record changer is mounted on a pull-out drawer.

The living room wall in which the equipment is installed divides the garage from the house. Easy accessibility for servicing is provided by removing the backs of the panels on the garage side. The contractor, G. W. Leckrone & Sons, Inc., plans to equip each home in the development with the "Custom Music Ensemble" manufactured by General Electric Co., Syracuse, N. Y.

F-M Military Radio . . . Frequency-modulation radio equipment newly developed for the U. S. Army Signal Corps provides sending and receiving facilities in the frequency range of 100 to 400Mc for relaying a broadband signal of 250 to 68,000cy over a line-of-sight path. One link would require only one set at each end, but where multi-link coverage is desired, one set would be used at each end of the system and two sets would be used at each relay point connected "back to back".

Designated AN/TRC-24, the gear has a 45-ft antenna mast divided into nine easily assembled sections. The antenna consists of two half-wave dipoles, which may be polarized horizontally or vertically. Developed by the Bell Telephone Laboratories, the AN/TRC-24 is manufactured by Western Electric Co., Inc., 195 Broadway, New York 7, N. Y.

Tiny TV Station . . . Transmitting over a maximum of only three miles, a tiny 8w TV transmitter at the U. S. Air Force Base, Limestone, Me., provides 10 hours of major network programs daily for the base's 15,000 personnel.

Designed as a morale aid, the station broadcasts in an area not covered by commercial stations. A grant of $34,000 from the Strategic Air Command's welfare fund paid for the installation, which was designed, built and erected at cost by the Radio Corporation of America. The equipment and studio are housed in a 10′ x 13′ shack atop the 4-story base hospital.

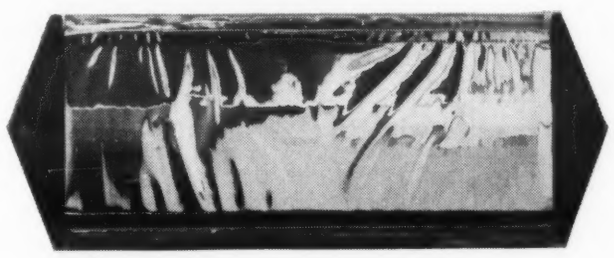
Movie on Stamping . . . A thorough tour of a modern metal stamping plant is shown in "Stampings For Electronics", a 20-minute 16mm color movie available for free showings to technical societies, industrial management, and other interested groups.

The design and construction of accurate progressive dies for subminiature and other sizes of stampings for electronic components is a feature of this filming of the John Volkert Metal Stampings, Inc., plant at 222-34 96th Ave., Queens Village 29, N. Y.

Tiny Speaker . . . No larger than a candy bar, the newly developed "Kilosphere" loudspeaker accurately reproduces frequencies in the treble range. The unit is a perforated metal oblong with about 1000 tiny rectangular aperatures, encased in a metallized-plastic foil. One of the speakers is shown in the photograph below. It is 5″ long by 2″ wide by 3/8″ thick.

Each of the 1/8″ x 25/1000″ aperatures acts as a speaker when the covering foil is set into vibration by the output from the audio amplifier. Since electrostatic force is applied over the entire speaker instead of a single point, as in conventional cone speakers, the aperature speakers all operate in phase. Distortion due to variations in phase is thus eliminated, and excellent reproduction in the treble range is made possible.

The Kilosphere produces an unusually smooth sound pressure curve in the range from 3000 to 20,000cy. In operation, it is driven from a band-pass filter that eliminates the lower frequencies, which



are reproduced by a conventional "bass" speaker. Developed by Columbia Records, Inc., 799 Seventh Ave., New York 19, N. Y., the new-type speaker is being incorporated in this firm's Type 360 phonograph and in a table-model tape recorder. Two of the Kilospheres and a pair of 6″ speakers are mounted in the phonograph. These speakers will eventually be offered to other manufacturers.

For more information on developments described in "Engineering Review", send inquiries directly to the address given in the individual item.

Engineering Review . . .

TV-Phone Intercom . . . A telephone user can see the person with whom he is speaking by using the newly developed TV-Telephone Intercom System. When the person making the call lifts his handset, his image appears on one-half of the 17″ TV screen. As soon as the called person answers, his image appears on the other half of the screen.

Kalbfell Laboratories, Inc., P. O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif., developers of the system, envisage a number of applications. Purchasing agents can use the device for selecting merchandise at a considerable saving in time. Personnel identification and personnel interviews, inter-plant and inter-city conferences can be conducted by TV at considerable savings in time and money.

When the telephone is not being used for communication, the TV monitor can display regular TV broadcasts, closed-circuit transmissions, or subscription TV. For the latter purposes, the image covers the entire screen. The system features a vidicon pick-up tube with circuitry similar to this firm's standard TV camera, which has an 8Mc bandwidth and a horizontal resolution about twice that of standard TV receivers.

The pick-up tube is mounted over the screen and tilted to scan a person seated a few feet away. A simple adjustment enables either party to make the entire screen available. The handset is mounted to the right of the screen.

Oscillograph Records 12 Parameters . . . A new 12-element oscillograph for monitoring power lines will wait indefinitely with no parts in motion until a fault occurs, when it will start and come to full recording speed in 2millisec. After it has started, the instrument will continue to run until the fault is cleared. It will then stop, record the time, and reset itself in readiness for the next fault.

The device was described at the recent AIEE Summer and Pacific

General Meeting, Los Angeles, in a paper entitled "A New 12-Element Automatic Oscillograph and Applications on the Bonneville Power Administration" by C. M. Hathaway and W. L. Davis, Hathaway Instrument Co., Portland, Oregon, and J. R. Curtain of the power administration. It automatically records 12 quantities of voltage, current, power, and the approximate location of faults, enabling engineers to take quick remedial action.

It can take as many as 100 consecutive records without any supervision, even if faults are days or weeks apart. Records are made on photosensitive paper. The recording paper travels at the rate of 12′ per second.

Rubber Dies for Tin . . . The cost of tin-base die casting has been materially reduced with the development of rubber dies, which are used in conjunction with a simple centrifugal casting process, according to the August, 1954, issue of *Tin News*, published by the Malayan Tin Bureau, 1028 Connecticut Ave., Washington 6, D. C.

Transistorized Engine Room . . . A robot bearing temperature monitoring system that employs transistors has been developed for use in the engine rooms of U. S. Naval vessels. When one of the bearings reaches its critical temperature, an alarm sounds and a signal light glows to indicate the troubled area. By turning a switch, a miniaturized electronic indicator then gives the duty engineman a precise temperature reading.

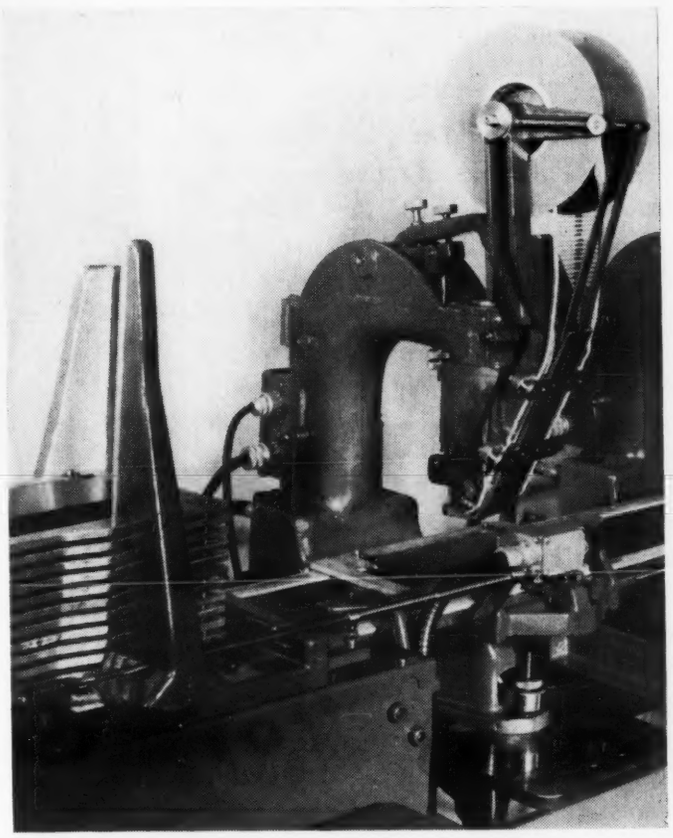
Capable of steadily monitoring some 40 locations, usually in the turbine area, the system was developed by the Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa. A prototype system utilizes three transistors in each of 40 amplifiers. Thermistors imbedded in the bearings act as the sensing elements. Printed circuit techniques were employed in the amplifiers. The complete transistorized systems draws less than 30w input power.

CIRCLE ED-9 ON READER-SERVICE CARD ➤

Engineering Review . . .

Automatic Production of Printed Circuits . . . Machinery that automatically inserts certain components into printed-wire boards has been developed. The experimental system is planned as the nucleus of a completely automatic method of producing printed-wire circuits using conventional components. One of the machines in the system is shown below.

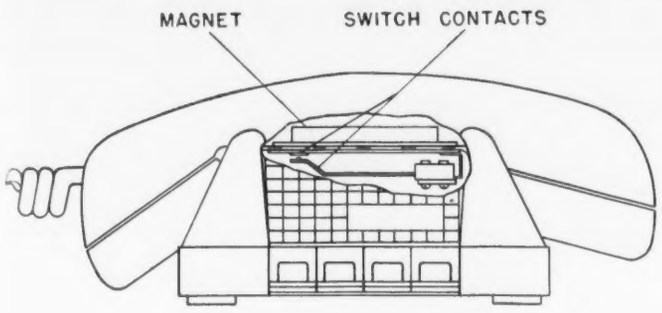
Developed by the Research Div., United Shoe Machinery Corp., 140 Federal St., Boston, Mass., the equipment processes 5″ x 8″ boards at the rate of 9600 per 8-hr day. The experimental machine will only insert resistors, tubular and disc capacitors, jumper wires, and eyelets in pre-punched holes in the board. Additional inserting heads for tube sockets, coils, and other components have not as yet been developed.



"Belted" resistors are running out of the spool at the top and being inserted into 5" x 8" printed-wired circuit boards by this United Shoe Machinery Corporation experimental machine.

An important part of the system is the "belting" of pigtail components in order to secure the best feeding conditions. After their leads are automatically straightened, the components are secured by their leads to two parallel-running strips of tape like the ties on railroad track. The belted components are wrapped on spools. One machine has already been built for "belting" resistors.

The spools feed the resistors into the inserting



Permanent-Magnet Switch

The familiar "pop-up" button has been eliminated in this telephone by the use of a permanent magnet. The switch controlling the circuit is held open by the magnet until the handset is lifted off the base. Since the switch is completely enclosed, dust is kept out of the base. The unit was developed by the Connecticut Telephone & Electric Co., Meriden, Conn., using a magnet manufactured by Carboloy Dept., General Electric Co., Detroit, Mich.

heads, which automatically cut and form the wire leads and insert them through the pre-punched holes. At the same station, the lead ends protruding through the board are automatically clinched to hold each component in place until the board is dip soldered. To avoid damage to the bodies of the components, they are handled by their leads throughout the entire operation.

To insure uniformity in the completed product, there are several safeguards in the experimental machine. Included are provisions to stop the machine when a station is empty, when a component is missing or not correctly inserted, or when an inserting head does not complete its cycle. Another automatic system for producing printed-wire circuits is shown on pp. 32 and 33.

TV "Booster" System . . . A 23db improvement in field intensity in at least 50% of the reception areas resulted from a test of a TV "booster" in conjunction with regular station transmission. In effect, the "booster" equipment receives the original signal from the station's main transmitter, amplifies it, and then broadcasts the amplified signal throughout the local area where signals from the main station are weak.

The 10w booster gear was located some 37 miles from the 1000w main transmitter. The demonstration was conducted by the Radio Corporation of America, 30 Rockefeller Plaza, New York 20, N. Y., in cooperation with WJTV, Jackson, Miss., under a temporary FCC grant. A 70-page report entitled "An Experimental Investigation of the Engineering Aspects of a UHF Booster Installation" is available to interested persons.

Meetings

September 13-24: *First International Instrument Congress and Exposition,* Commercial Museum and Convention Hall, Philadelphia, Pa. For information, write to A. H. Peterson, Mellon Institute, Pittsburgh 13, Pa.

September 15-17: *Symposium on Information Theory,* Massachusetts Institute of Technology, Cambridge 39, Mass. Sponsored by the Professional Group on Information Theory, IRE, and others. For information, write to Dr. R. M. Fano, Research Laboratory of Electronics, M.I.T.

September 16-18: *Joint Electron Tube Engineering Council, General Conference,* Chalfonte-Haddon Hall, Atlantic City, N. J.

September 29-30: *Symposium on Industrial Electronics,* Mellon Institute, Pittsburgh, Pa. For information, write to Dr. J. B. Woodford, Jr., Electrical Engineering Dept., Carnegie Institute of Technology, Pittsburgh 13, Pa.

October 4-6: *Tenth Annual National Electronics Conference,* Hotel Sherman, Chicago, Ill. For information, write to R. E. Honacek, Illinois Bell Telephone Co., 208 W. Washington St., Chicago 6, Ill.

October 4-13: *International Telecommunication Union,* Geneva, Switzerland. For information, write to Secretariat, ITU, Palais Wilson, Geneva.

October 11-15: *AIEE Fall General Meeting.* Morrison Hotel, Chicago, Ill. Special emphasis will be on electrical aspects of air transportation, with eight sessions planned on this subject. For information, write to AIEE, 33 W. 39th St., New York 18, N. Y.

October 12: *Ferromagnetism Conference:* Naval Ordnance Laboratory, Silver Springs, Md. For information, write to L. R. Maxwell, U.S.N. Ordnance Laboratory, Silver Spring, Md.

October 13-17: *1954 Annual Convention, Audio Engineering Society,* Hotel New Yorker, New York, N. Y. For information, write to C. J. LeBel, P. O. Box 12, New York 11, N. Y.

October 18-20: *Radio Fall Meeting,* Hotel Syracuse, Syracuse, N. Y. For information, write to Radio-Electronics-Television Manufacturers Association, 777 14th St., Washington 5, D. C.

October 18-20: *Conference on Electrical Insulation,* Pocono Manor Inn, Pocono Manor, Pa. For information, write to D. A. McLean, National Academy of Science, 2101 Constitution Ave., Washington 25, D. C.

October 26-28: *National Conference on Tube Techniques.* Western Union Auditorium, 60 Hudson St., New York 13, N.Y. Sponsored by Working Group on

CIRCLE ED-300 ON READER-SERVICE CARD FOR MORE INFORMATION ›

DESIGN and PRODUCTION NEWS

FOR ELECTRICAL AND ELECTRONIC ENGINEERS

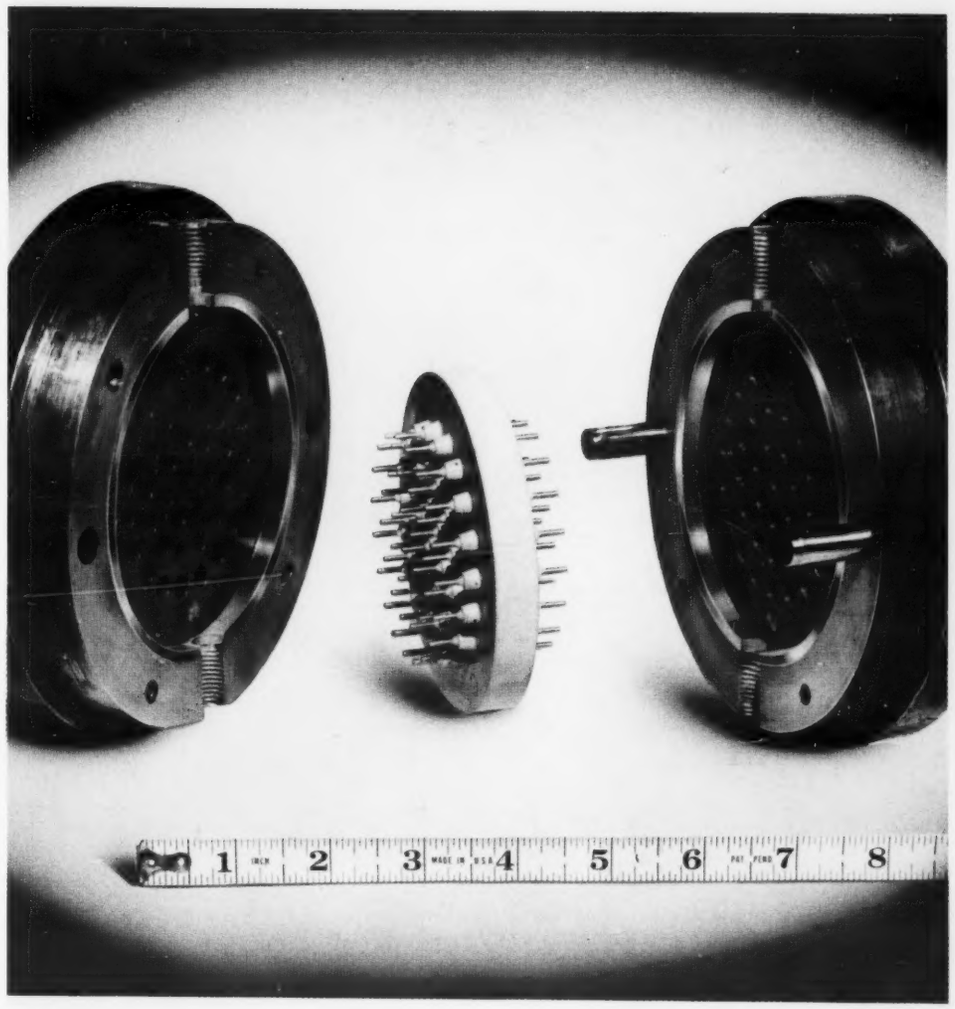
Published by TECHNICAL SERVICE, Chemical Manufacturing Division, The M. W. KELLOGG Company AUG.-SEPT. 1954

Casting Molds of KEL-F® Polymer Replace Plated Metal Molds... Cut Costs, Finishing and Rejects!

Complex electrical terminal boards, made of an especially abrasive epoxy compound, are now cast in molds of KEL-F polymer, replacing former metal molds. Advantages include lower original mold costs, lower maintenance costs, fewer rejects and higher product precision without extensive machining.

Excellent wear characteristics of the new molds result in longer mold life despite high silica content of the casting resin. The non-hesive properties of KEL-F polymer prevent pitting by the resin, result in damage-free release of the product without special coatings. Penn-Plastics Manufacturing Company, Glenside, Pa., produce these intricate new molds by transfer methods. Molded of KEL-F polymer Grade 300, they are designed to hold 40 terminal pins and to impress forty 1/16" numerals in both faces of the finished part. Terminal boards are manufactured by Penn-Plastics in conjunction with Woodmont Products, Inc., electronic parts manufacturers of Huntingdon Valley, Pa.

For further information ask for Application Report P-101



Wafer-thin Insulator Mount of KEL-F® Polymer Increases Life of Miniature Switch to 5-Million Cycles!

A wafer of KEL-F polymer provides a tough, insulated mount for a contact bar, guards the performance of this sealed precision switch under severe thermal cycling. Currents up to 10 amps are handled for a life of from 1 to 5 million cycles.

This fluorocarbon plastic is molded directly to the beryllium-copper switch blade. It insulates the switch blade against arc-heat damage and its dimensional stability guarantees positive contact position for service between minus 90°F and plus 200°F . . . without shorting. Haydon Switch, Inc., Waterbury, Conn., utilizes insulation molded of KEL-F polymer Grade 300 in single- and two-circuit snap switches for automatic equipment used in aircraft, marine and industrial applications.

For further information ask for Application Report E-125

(SEE REVERSE SIDE)

® Registered trade-mark for The M. W. Kellogg Company's fluorocarbon Polymers.

CONTINUED FROM PRECEDING PAGE

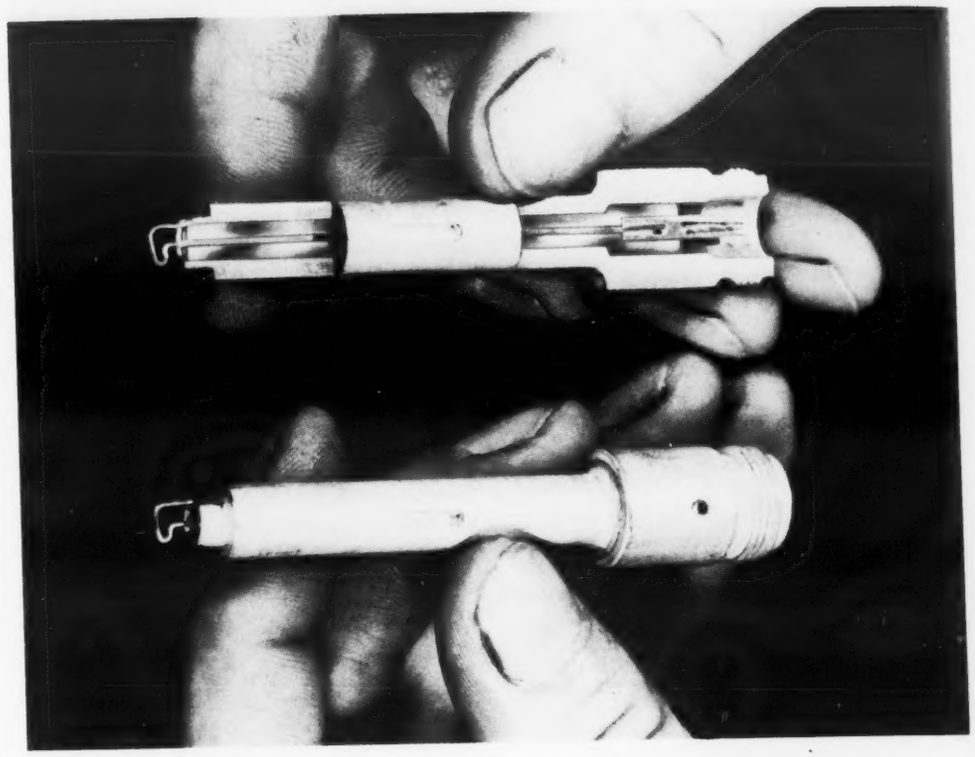
Only One RF Signal Probe, Insulated with KEL-F® Plastic, Now Needed for Entire 500 to 5,000 Mc Range

Specification of KEL-F polymer plastic as the insulation for this wavemeter probe resulted not only in a widened instrument range and accuracy, but increased efficiency and life as well.

This readily-molded fluorocarbon plastic permits complete, "tight" insulation of the vital filaments in a single operation. Excellent electrical properties of KEL-F polymer under high humidity and thermal cycling eliminate leakage and shorts. High strength and dimensional stability prevent insulation failure from cracking or shrinkage in service.

Thompson Products, Inc., Cleveland, Ohio, insulates the probe by injection molding, using KEL-F polymer Grade 300. It is used in the company's Model WIN6AA Wavemeter.

For further information ask for Application Report E-126



Molders & Fabricators of the Month

Leading molders, extruders and fabricators specialize in the production of materials and parts made of "Kel-F" . . . each month this column will spotlight several of these companies with their principal services and products.

Consolidated Molded Products Corp.
Scranton, Pa.
Compression & transfer molding
Injection molding

Cortland Industries, Inc.
Chicago, Ill.
Sealing of film
Production machining

General Plastics Corporation
Paterson, N. J.
Dispersion Coating

United States Gasket Company
Camden, N. J.
Extrusion
Forming & machining
Injection, compression & transfer molding
Rod, tube and sheet; tube sockets
Gaskets, gauge glasses & tower packing

The William Brand and Company, Inc.
Willimantic, Conn.
Insulated wire

Recent Significant KEL-F Polymer Developments . . .

Pyrex-to-steel seal is effected in a new centrifugal pump with a resilient O ring of KEL-F plastic. Damage to the glass observation plate, leaks at high pressures have been eliminated.

Electronic tubes used at high altitudes are now hermetically sealed in new sockets made of fluorocarbon plastic. Consistent hermetic seal over a wide temperature range, low "arc-over" and shock damage are major features.

Conductivity cell-valve units for testing potable water use KEL-F polymer as a structural and electrical insulating member. Immersed continuously in water at temperatures up to 250°F, machined insulator maintains critical electrode gap.

Pump vanes of molded glass-filled polymer have been found to have the necessary strength as well as complete chemical inertness to stand up under hot, extremely corrosive chemicals in a new transfer pump.

OFF THE PRESS . . .
Revised "BUYERS GUIDE" listing KEL-F polymer products, molders and fabricators.

Tube Techniques, Dept. of Defense. Papers should be submitted to Dr. Harold Jacobs, Thermionics Branch, Evans Signal Laboratory, Belmar, N.J. For information, write to Harold J. Sullivan, Advisory Group on Electron Tubes, 346 B'way, N. Y. 13, N.Y.

November 4-5: *East Coast Conference on Airborne and Navigational Electronics.* Sheraton-Belvedere Hotel, Baltimore, Md. For information, write to IRE, 1 East 79th Street, New York, N.Y.

November 8-10: *Symposium on Modern Advances in Microwave Techniques,* Engineering Societies Bldg., 33 W. 39th St., New York 19, N. Y. For information, write to Polytechnic Institute of Brooklyn, Microwave Research Institute, 55 Johnson St., Brooklyn 1, N. Y.

November 10-11: *Conference on Electronic Instrumentation and Nucleonics in Medicine.* Morrison Hotel, Chicago, Ill. For information, write to AIEE, 33 West 39th Street, New York 19, N. Y.

November 15-17: *ASA Fifth National Conference on Standards.* Hotel Roosevelt, N.Y.C. For information, write to Public Relations Director, ASA, 70 E. 45th St., New York, N. Y.

November 18-20: *Symposium on Precision Electrical Measurements,* National Physical Laboratory, Teddington, England. For information, write to Director, NPL, Teddington, Middlesex, England.

November 29-December 3: *First International Automation Exposition,* 242nd Coast Artillery Armory, New York, N. Y. For information, write to First International Automation Exposition, 845 Ridge Ave., Pittsburgh 12, Pa.

December 8-10: *Eastern Computer Conference,* Bellevue-Stratford Hotel, Philadelphia, Pa. The theme of the Conference is, "Design and Application of Small Digital Computers". For information, write to Eastern Joint Computer Conference, P. O. Box 7825, Phila. 1, Pa.

January 17-19: *High Frequency Measurements Conference,* Hotel Statler, Washington, D. C. Sponsored by AIEE and IRE. One-hundred-word abstracts of papers to be submitted should be sent to the chairman of the appropriate session listed as follows: Frequency and Time Measurements, Dr. B. M. Oliver, Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.; Power and Attenuation Measurements, E. W. Houghton, Bell Telephone Laboratories, Murray Hill, N. J.; Impedance Measurements, Dr. D. D. King, Johns Hopkins Univ., Baltimore, Md.; and Measurements in Transmission and Reception, B. Parzen, Olympic Television and Radio Co., 34-01 38th Ave., Long Island City 1, N. Y. For information, write to AIEE, 33 West 39th St., New York 19, N. Y.

CIRCLE ED-300 ON READER-SERVICE CARD

PRINTED CIRCUIT techniques a
and more popular in electronic
signers, aware of the many attracti
herent in these techniques, are eag
printed circuits in their electronic
much has been written on the fab
duction techniques of printed circ
information, however, has appeared
a printed circuit.

It is the purpose of this series of
such information. We will begin wit
of the more important basic design
printed circuits. A designer can u
for deciding whether or not to u
techniques in a given piece of equip
cided to use printed circuits, these
the designer so that he will avoid
errors at the very outset.

Succeeding articles will cover th
in greater detail. In this way it is
the confusion and mistaken notions
ed circuits may be dispelled, and tha
engineers will be encouraged to tak
relatively new technique, which hol
for the future of the electronic indu

Advantages of Printed

Why should a designer consider
circuits? Over the past three or fo
of answers to that question have evo
circuits, all the solder joints in an
may be made at one time by di
circuit card with its associated com
bath. Where hand soldering is exp
cuits affect considerable savings.

Table 1. Currents sufficient to c

Foil width (Inches)	Burnout Copper foil .0014" thick
1/64	3
1/32	5
1/16	10
1/8	15
1/4	23

Printed Circuit Design

I—Basic Design Factors

By George Maisch, Chief Electronic Engineer,

Photocircuits Corp., Glen Cove, N. Y.

PRINTED CIRCUIT techniques are becoming more and more popular in electronic applications. Designers, aware of the many attractive possibilities inherent in these techniques, are eager to incorporate printed circuits in their electronic devices. Although much has been written on the fabrication and production techniques of printed circuits, little or no information, however, has appeared on how to design a printed circuit.

It is the purpose of this series of articles to present such information. We will begin with a survey of some of the more important basic design factors involved in printed circuits. A designer can use these as a basis for deciding whether or not to use printed circuit techniques in a given piece of equipmnet. Having decided to use printed circuits, these factors can guide the designer so that he will avoid some basic design errors at the very outset.

Succeeding articles will cover these design factors in greater detail. In this way it is hoped that some of the confusion and mistaken notions surrounding printed circuits may be dispelled, and that electronic design engineers will be encouraged to take advantage of this relatively new technique, which holds so much promise for the future of the electronic industries.

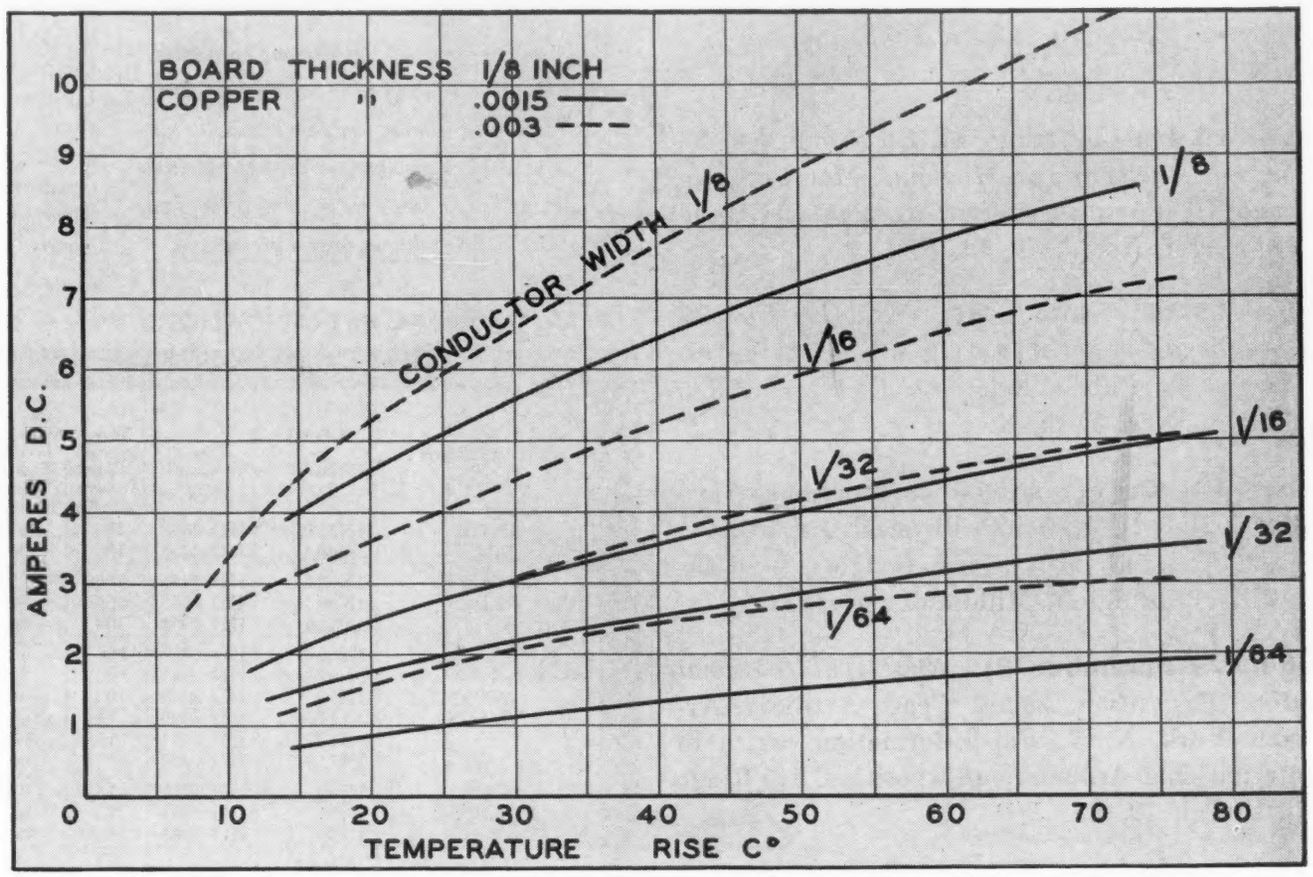


Fig. 1. Current carrying capacity vs temperature for various widths of copper foil.

Advantages of Printed Circuitry

Why should a designer consider the use of printed circuits? Over the past three or four years, a number of answers to that question have evolved. With printed circuits, all the solder joints in an electronic assembly may be made at one time by dipping the printed-circuit card with its associated components in a solder bath. Where hand soldering is expensive, printed circuits affect considerable savings.

Table 1. Currents sufficient to cause foil burnout.

	Burnout current (amperes)	
Foil width (Inches)	Copper foil .0014" thick	Copper foil .0028" thick
1/64	3	5
1/32	5	8
1/16	10	15
1/8	15	20
1/4	23	35

Automatic manufacturing methods are readily applied to printed circuits production. Most or all of the components can be machine inserted in a printed circuit card (see pages 12, 32 and 33 of this issue). This eliminates hand wiring errors as well as a large part of assembly labor costs.

Prototype designs can be adhered to on the production line. In the production of conventional electronic equipment, production engineers must often alter the prototype by changing component positions, lead dress, etc. Assemblers further affect these factors, leading to variations from the prototype as well as changes between production models. Unwanted effects such as instability of feedback loops, stray capacitances and inductances, etc., are easily introduced by these deviations from the prototype model. With printed circuits, the design engineer can freeze these variables and keep them under control. Performance characteristics that are determined by conductor width and pattern layout, change very little from one assembly to another.

Another advantage of printed circuits is that this technique permits making many devices that are almost impossible to produce in any other way. Complex switches and code wheels are typical examples.

Design Considerations

In order to realize these and other advantages of printed circuits, a number of very important factors must be kept in mind by the designer. Failure to do so will increase the cost of the assembly and create production problems that can easily nullify all of the advantages previously mentioned.

Process Limitations—As seen in Fig. 2, conductor patterns are produced by various methods. The steps

in the making of plated-through holes are also illustrated. (This series will consider printed circuits produced by only one method—etched metal foil adhering to plastic sheets. However, portions may apply to other systems where techniques are similar.) There are inherent limitations in the process that limit a designer's freedom of effort in creating a pattern. The most important of these limitations involves considerations of line width, line spacing, and "undercut."

Line Width—Since no printing process is perfect, lines that are too narrow result in a high production reject rate because of nicks, pinholes, or other imperfections. Although etched patterns with line widths as narrow as 0.005″ can be made, a practical minimum width for economical production is 0.020″.

Line Spacing—Similarly, the use of narrow spaces between lines results in unetched copper or short circuits. Patterns have been produced with spacings as narrow as 0.005″, but for economical production, a minimum spacing of 0.020″ is recommended.

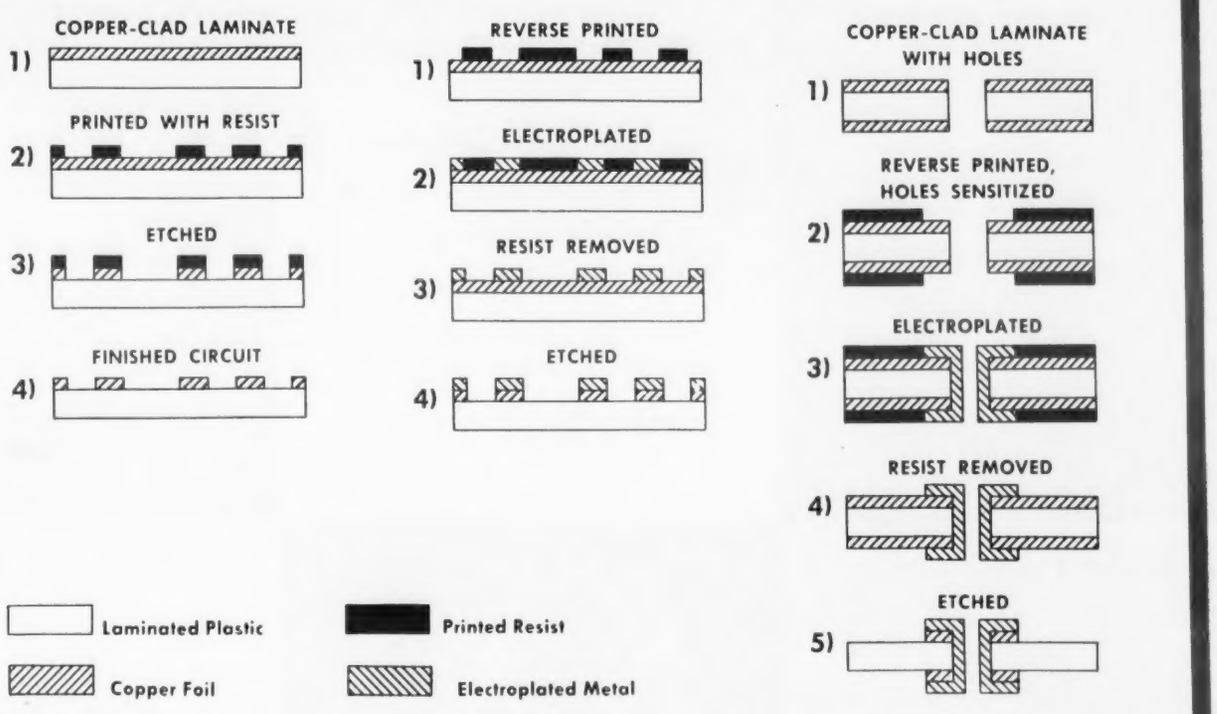
Undercut—For each unit of depth of metal removed by etching an approximately similar unit in width under the protective resist is also removed. Due to the small dimensions involved, this is generally ignored, but it must be said that the effect is to make thin lines thinner, narrow spaces wider, and small holes larger. The term used to describe this condition is "undercut". The designer can compensate for this condition by making lines wider on his master drawing. For example, in etching through copper 0.0027″ thick, 0.002″ to 0.003″ will be lost from the edge of the line. If a line is to be 0.030″ wide, the designer should make the line on the master drawing wide enough so that the printed resist line comes out 0.036″ wide.

Electrical Considerations—Most of the electrical considerations relating to printed circuit design revolve about the fact that the conductor pattern is bonded to some kind of dielectric material. The surface and volume resistivity of this material, as well as its dielectric constant and dielectric loss factor place significant limitations on designs. Environmental conditions such as temperature and humidity also must be considered. The designer has to select his dielectric material with all these factors in mind. The physical layout of the circuit pattern will be influenced by the electrical properties of this material.

Mechanical Considerations—The insulating material also influences the mechanical considerations in printed circuit design. Resistance to shock and vibration, deformities due to temperature, abrasion resistance, and similar mechanical characteristics are governed by the choice of materials for the conductor pattern and the insulating support.

Current-carrying Capacity—The designer of a printed circuit must know something of the ability of an etched foil circuit to carry an electric current. It will generally be found that patterns of very narrow lines will conduct ample current for a typical electronic circuit.

Fig. 2. Printed-circuit fabrication. At the left are the steps in the etched-foil process. The plated-foil method is illustrated in the middle, and the steps in the making of plated-through holes can be seen at the right.



Methods of applying the resist ink

Method	Application	Technique
Photo-resist	Small lot runs; high degree of accuracy in fine details	Foil surface coated with light sensitive enamel. Portion exposed to light through transparent portions of negative becomes resistant to mordant
Screen printing	For large runs	Resist ink screened on surface of foil in typical silk screen operation
Offset printing	For large runs	Resist ink transferred to foil from inked offset plate

The major considerations remain those previously described under etching limitations as well as maintaining a line commensurate with the design under development. The table and curves shown on these pages present some basic data on the current-carrying characteristics of copper-foil. They can be used as a guide in setting up the original design. Note that for most electronic circuits, with the possible exception of heater circuits, the line dimensions may be quite narrow.

Conductors that may be required to carry current several times normal because of some abnormal condition must be made wider. Low impedance circuits, such as the filament leads in a vacuum tube circuit, are typical examples. Plate circuits, although likely to develop short circuits, are usually protected by a series resistor or other means to prevent currents sufficient to burn out part of the foil conductor. Before laying out a printed wire pattern, the designer must determine approximately how wide each copper foil should be.

Circuit Markings—A desirable feature, which may be included at no extra cost other than the time required in the initial drawing, is copper-foil markings on the base to identify nearby components, to indicate correct voltage readings at certain points, and to give

any other information that will aid in the identification or service of an assembly. Again the same caution used in determining line width and other problems in etching must be observed. If small markings are used, small isolated areas in letters and numerals should be filled in to appear as a solid area. This will help hold the letter intact. Numerals and letters should be not less than 3/32″ high.

Mounting Considerations—It is not good design practice to mount speakers, transformers, big capacitors, and similar parts on a printed circuit card. They are usually better mounted on an associated rigid metal chassis.

A means of mounting a printed assembly must be included in the layout of the pattern. This may be nothing more than provision for holes with adequate clearance for screw heads and other hardware.

Printed wiring ordinarily involves exposed wiring with the danger of electric shock. Suitable provisions must be made to avoid this possibility. For example, the printed circuit may be coated with an insulating plastic or it can be placed in a protecting container.

Subassembly Techniques—Ordinarily most radio and TV circuit assemblies are too large to be made as a single assembly even in hand-wired units. The subassembly system of design is necessary with printed wiring since assemblies should be made small enough for convenient dip soldering, fabrication, and handling in automatic equipment. This is very useful in servicing equipment. A small section of a circuit can be quickly replaced to effect a repair if it is a subassembly. Thus, a necessity becomes an advantage.

Warpage—It is difficult to obtain perfect flatness in printed circuit boards. Any design should be so arranged that a small amount of warpage will not result in an awkward assembly procedure or shorts to adjacent components or chassis. Standards deemed acceptable by plastic manufacturers allow for large deviations from flatness and apply to large sheets. Table 2 gives information on warpage allowed on the laminates. Warpage is reduced when the material is cut to circuit-board size, but is still apparent and should be considered. This difficulty arises most often when using laminated plastics with copper on one side only. Therefore, if a problem of insufficient clearance be-

Table 2. Maximum warp (in percent) based on 36″ dimension. These values do not apply to cut pieces, but only to sheet sizes as manufactured.

Range of Thickness (Inches)	Copper on One Side		Copper on Two Sides
	0.0014″	0.0028″	Both Thicknesses
1/32 to 3/64	20	24	6
3/64 to 1/16	15	18	6
1/16 to 1/8	10	12	3
1/8 to 1/4	5	6	1.5

From National Electrical Manufacturers Assn. Bulletin LPI-7.04

cause of permissible warpage exists, a circuit with copper foil patterns on both sides of the laminate is desirable.

Space Considerations—Miniaturization has been mentioned as a major benefit in printed circuitry. Where subminiature components are used this is true, but in accepted radio and TV designs, miniaturization may not be achieved. In fact, the opposite, or an expanded circuit may result.

It has been standard practice in wired assemblies to bunch components about tube sockets in a manner that allows components to be mounted at random angles and stacked above each other in two or more layers. Such a means of assembly has been found convenient and efficient due to the shortness of leads and the use of the tube socket and its mounting as tie and ground points. In present printed wiring practice components are usually mounted in a single layer in relatively close contact with the plastic. This results in an expanded circuit that, due to the longer circuit leads, may prove less efficient, especially in high frequency applications. A means of assembling smaller circuit boards and then arranging in multiple or stacked layers is used to overcome this condition (see p. 33 for one example of "stacked" construction).

Printed Circuit Costs—The cost of a printed circuit depends primarily upon the type of laminate material selected; the size, shape, and thickness of the board; the thickness of the foil employed; the complexity of the fabrication required to produce the finished printed circuit; the quantities of items that will be produced; as well as the design costs involved in making the original layout of the wiring pattern. It is easy to see that because of the many variables that must be considered, no accurate general statement on cost can be made. In fact there are times when it may be economical to produce a single printed circuit for a certain application. On the other hand, printed circuit techniques may not prove economical at all for another use even though fairly large quantities are involved.

In the last analysis, the economic advantage of printed circuits does not depend upon the cost of the circuit itself, but on the relative cost of the circuit compared with its conventional equivalent produced by hand-wiring methods. The designer must weigh all the factors concerned to arrive at a workable and economically practical answer.

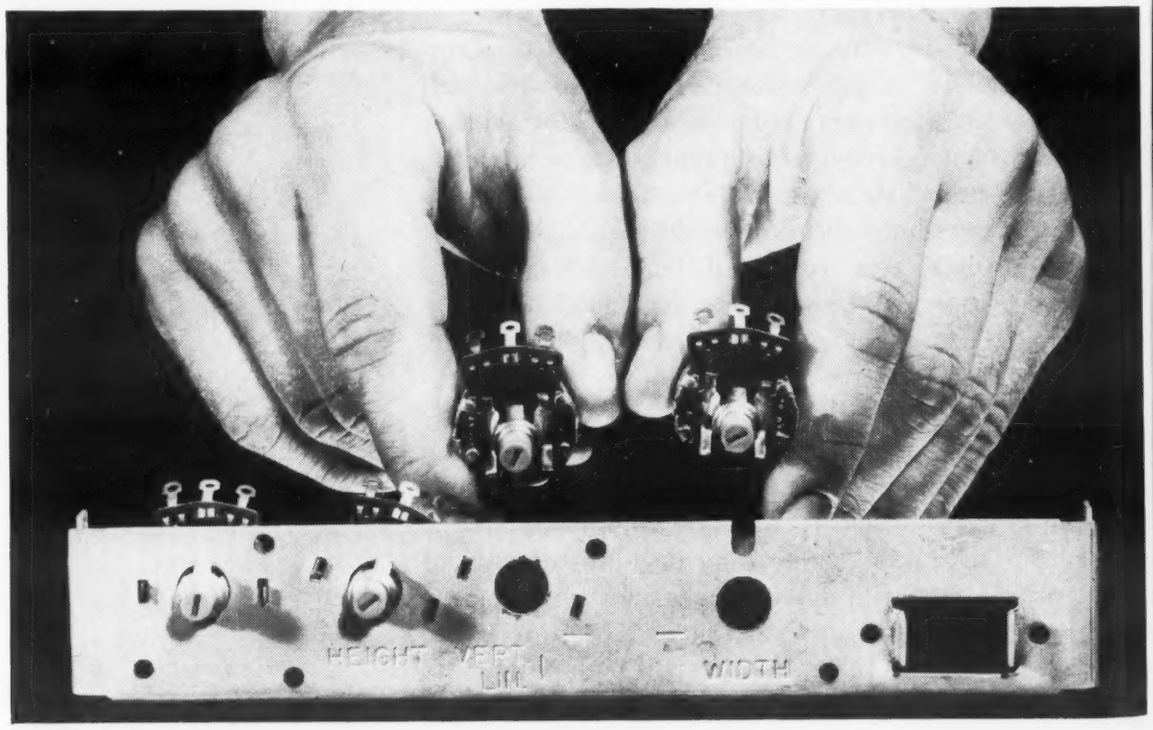
Making the transition from conventional hand-wired equipment to printed circuitry need not be difficult for the designer, regardless of the complexity of the equipment involved. By keeping in mind the various basic design factors previously mentioned, many costly mistakes can be avoided at the very beginning of a project. Following the rules that will be laid down in succeeding articles in this series will help the designer create a circuit that is readily fabricated and one that will give him the performance originally proposed for his design.

Easily-Installed Controls

SIGNIFICANT production-cost savings in the mounting of controls can be gained by use of the "Snap-Tite" control shown in the drawing. No tools, hardware, or twisting of tabs are required to mount them. As shown in the photograph, an operator can push two of these controls into place at one time.

Six spring clips on the control fit into the standard tab and bushing holes in chassis. No panel retooling or production line rearrangements are required to accommodate them. The controls are primarily designed for fine-adjustment applications in TV and electronic equipment. The units have a short knurled and slotted shaft for fingertip or screwdriver adjustment. The shaft is molded of high-impact, blue-colored, polystyrene plastic for best electrical insulation and mechanical strength. It extends 1/2" from the face of the mounting panel. The length of the 1/4" diam shaft is 31/64". The unit is less than 1" broad.

"Snap-Tite" Controls are quickly installed two at a time without tools. Clips hold them in place.



Available in standard resistance values and tapers, the "Snap-Tite" control is manufactured by Centralab, Division of Globe-Union, Inc., 900 East Keefe Avenue, Milwaukee 1, Wisc. They fit into panels of from 0.045" to 0.065" in thickness, 16 to 19 gage, respectively.

These controls can also be used to advantage for installation in inaccessible places, since they do not require tools. For more data, turn to Reader-Service Card and circle **ED-17.**

Sideview of the unit showing the securing spring clips.

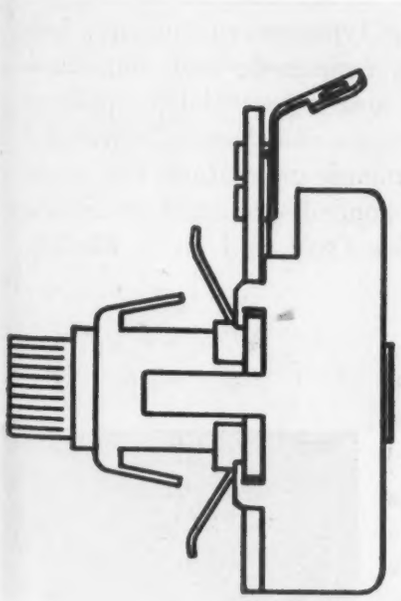


Fig. 1. The "whisker wire" in this 1/4" long, glass-encased diode is bonded to the semi-conductor forming a gold-germanium eutectic alloy at the junction.

High-Output Subminiature Diodes

FORWARD current ratings in the order of hundreds of milliamperes are characteristic of a new line of subminiature gold-bonded germanium diodes, one of which is shown in Fig. 1. Only 1/4" long x 0.1" diam, a number of the hermetically sealed units can be mounted in a small area (see cover). Produced with very uniform characteristics, the glass-encased diodes are rugged, stable, and can operate to 90°C. Divided into five classifications, the many types can

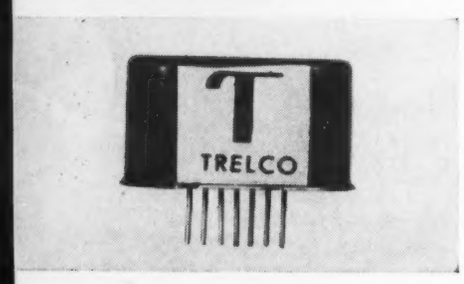


Fig. 2. The diodes are available in matched quads or pairs mounted in either octal bases (top) or 7-pin miniature bases (bottom).

be utilized in a variety of diode circuits, a few examples of which are given in Figs. 5 to 8.

Two outstanding characteristics of the diodes are demonstrated in the cathode-ray oscilloscope photos shown in Figs. 3 and 4 and on the cover. The lead wires are made of "Dumet", a composite metal with a temperature coefficient of expansion that matches that of glass. Manufactured by Transitron Electronic Corp., 403 Main St., Melrose 76, Mass., they are also furnished in matched pairs and quads mounted on octal or 7-pin subminiature bases as shown in Fig. 2.

Each of the circuits illustrated utilizes the outstanding characteristics of the particular type or types of gold-bonded diodes employed. In the core-switching circuit shown in Fig. 6, the high pulse-current capacity of Types *T25G* and *T6G* is important. The core is alternately magnetized in opposite polarity by the input and clock pulses. When the clock pulse is applied, there will be an output pulse only if the core had previously been magnetized in the opposite polarity to that of the clock pulse.

The diodes are used to prevent the backward flow of pulses into the input circuits, to provide unidirectional clock pulses from a push-pull clock source, and to avoid loading of the inputs by the other windings. The resistors isolate the cores from the diodes. It is desirable to use high pulse currents in this application, for the rise time, driving requirements, and physical size are simplified if fewer turns may be used on a winding. Pulse currents commonly used are from 50 to 200ma. Operation of gold-bonded diodes in this application is practicable up to 20Mc.

In the diode-capacitor memory matrix shown in Fig. 7, the input diodes are used to charge up the capacitor if a signal pulse is applied to any one of them. The output diode is normally biased in the inverse direction and does not interfere with this action. When it is desired to read out the presence or lack of stored voltage, the output diode is returned to zero bias, providing an output pulse if the capacitor has previously received a signal. This also serves to discharge the capacitor and erase any previous signals in the memory.

The capacitor charge will slowly leak off because of the inverse currents, I_d, of the diodes. The holding time will depend on this parameter and the size of the capacitor. The time required to charge up the capacitor also depends on its size and the short circuit current, I_s, available from the signal source.

If the circuit is arranged so that the input pulse will charge the capacitor for one time constant, and holding time is defined as that time required for the capacitor voltage to drop to half or less of its initial storage voltage, it can be shown that:

Holding Time/Charging Time $= 0.31\ I_s/I_d$.

The diodes' forward drop during the charging cycle is important under these conditions, and should be small compared to the source voltage to prevent a loss of stored voltage. In addition, the diodes should be uniform in inverse current to prevent the output diode from charging up the capacitor. The saturated or constant current nature of the gold-bonded diodes discussed here is helpful, for it prevents the capacitor from charging up to much more than about 1/2v.

When high-speed operation is desired, the inverse and forward pulse recovery characteristics may be important. Experiments with these units indicate that they are satisfactory in the range of 0.5μsec input pulses or larger.

The diodes can be furnished with a high degree of balance at high power levels. This feature is important for the following types of equipment: balanced modulators; phase, frequency, and amplitude discriminators; magnetic and differential amplifiers; suppressed carrier modulators and demodulators; d-c to a-c converters; and harmonic generators. For more information on these gold-bonded, subminiature diodes, turn to the Reader-Service Card and circle **ED-20.**

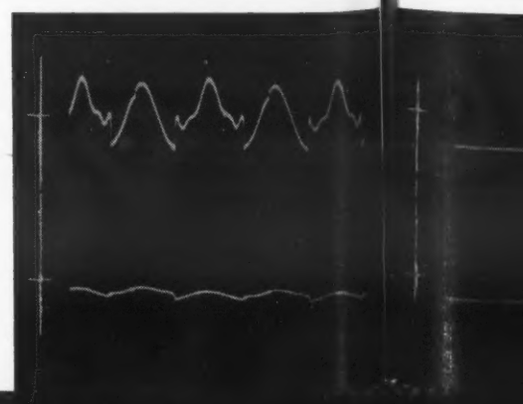


Fig. 3. An oscilloscope comparison of null voltage output between conventional point-contact diodes (top) and Type *T18G* Diodes in a balanced bridge circuit. The new diodes are more easily matched over the entire forward current range.

Fig. 5. A bridge rectifier circuit capable of delivering 7.3w at 140ma and 52v. Utilizing Type *T5G* Diodes, the component values are as follows: R = 350 ohms, L = 0.25h, and C = 10mfd. The input voltage, E_{si} is 57v at 400cy.

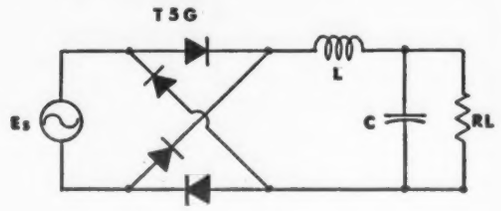


Fig. 6. This core-switching circuit can be used in shift registers, storage elements, delay lines, and as a pulse-shaper or gain stage.

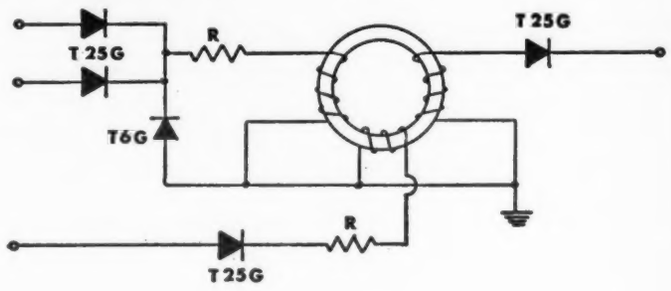


Fig. 7. A memory-matrix circuit.

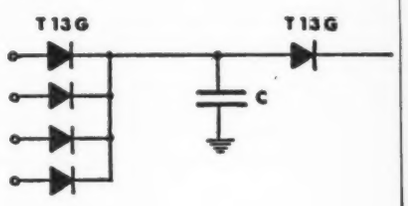


Fig. 8. A balanced rectifier circuit.

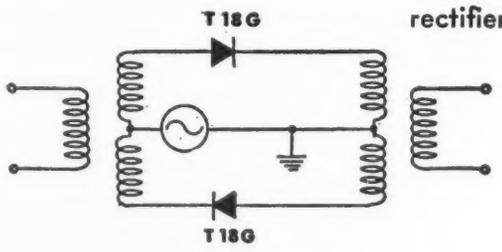


Fig. 4. The vertical scale is 8v/inch in this oscilloscope comparison of forward drop with a 100ma, μsec pulse applied to a conventional point-contact diode (top) and a Type *T25G* Diode.

CIRCLE ED-21 ON READER-SERVICE CARD FOR MORE INFORMATION

Measurement of Cable-to-Rigid Line VSWR

By A. B. Giordano, Professor of Electrical Engineering
Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Editor's Note: This article is an excerpt from the "Handbook of Microwave Measurements", edited by Moe Wind, Research Assistant Professor, and Harold Rapaport, Research Associate, Polytechnic Institute of Brooklyn. It is taken from the section on the measurement of standing wave ratio written by Dr. Giordano. The Handbook, recently published by the Institute, is available from the Microwave Research Institute, 55 Johnson St., Brooklyn 1, N. Y. It is printed in two volumes and is priced at $12.00.

TWO OF THE FOUR methods of measuring one of the electrical characteristics of rigid-line cable connectors, the cable-to-rigid line VSWR, are described in this article. The rigid-line connector connects cables to rigid lines, as distinct from cable connectors, which join cables to cables.

The cable-to-rigid line VSWR includes the effects of the electrical reflections arising from the cable-clamping device in the connector, and from the difference in characteristic impedance between the cable and the cable connector. The cable-to-rigid line VSWR is defined, as shown in Fig. 1, as the VSWR seen looking into the rigid coaxial line with the cable terminated in a matched load. It is assumed that the characteristic impedance of the cable connector and the rigid coaxial line are equal.

Four methods of measurement are possible for measuring cable-to-rigid line VSWR. These are:

1. Single-slotted-section method with long terminating cable.
2. Two-slotted-section method with one slotted section built around the cable.
3. Frequency variation method.
4. Variable-short-circuit method.

The single-slotted-section method assumes that the cable-to-rigid line VSWR can be measured if the connector is terminated by a cable of sufficient length and attenuation such that the characteristic impedance is observed at the input. This method is not reliable, however, because of the so called "periodicity effect" which may give rise to sudden changes in the input impedance of the cable, thus terminating the connector in a mismatched load. The two-slotted-section method can be used to measure the cable-to-rigid line VSWR provided one of the slotted sections is built having the cable as a core, hence a different slotted section is required for each different cable size. Cable slotted sections are ordinarily not available commercially and the accuracy and consistency of the results obtained with those that have been built are doubtful.

Frequency Variation Method

Direct cable-to-rigid line VSWR measurements can be made without the use of special cable slotted sections and lengths of periodicity-free cable by using the frequency variation-of-VSWR measurement technique. This method uses the same equipment as the two-slotted-section method with an added length of cable (long in terms of wavelength) as part of the sample. The procedure consists of measuring the VSWR in the input slotted section as a function of a small variation in frequency and determining the cable-to-rigid line VSWR from a graphical analysis of this information.

The arrangement of equipment for this method is shown in Fig. 2 and except for the adapters, is the conventional type used for making VSWR measurements described in the *Handbook*. Adapters for some cable connectors and coaxial line sizes are reported in the literature[1, 2]; these must be reflection-free and specifically designed for the particular cable and cable connector under test.

Measurement Procedure

1. Arrange equipment as shown in Fig. 2 and follow the general tuning and warm-up procedures indicated in Section 2.02, *Handbook*.
2. Adjust the signal source frequency to a value on one side of the nominal frequency of measurement. (See Section I, *Handbook*, for detailed procedures on the measurement of frequency and wavelength.)
3. Measure the standing wave pattern of the termination in slotted section No. 2. If the load termination is not matched (VSWR ≤ 1.02) use a tuner to match the load. (See Appendix D, "Impedance Matching Techniques", *Handbook*, for detailed descriptions of tuning devices and matching procedures.)
4. Measure the input VSWR of the test sample (cable and connectors) in slotted section No. 1.
5. Vary the frequency of the signal source by a small amount and repeat steps 3 and 4. (The frequency increment is dependent upon the nominal frequency of measurement and the length of the cable between the two test connectors. For a sample length of cable 50 wavelengths long, a total frequency excursion of from 2 to 5% yields sufficient information for graphical analysis. Hence, if the nominal frequency of measurement is 3000Mc, then about ten points spaced 15Mc apart defining at least one maximum and one minimum are enough.)
6. Repeat step 5 for approximately 10 different frequencies about the nominal frequency (or a sufficient number of closely spaced points) so that the curve of input VSWR as a function of frequency can be plotted, as shown in Fig. 3.
7. From the plot of input VSWR versus frequency, determine ρ_{max}, the maximum VSWR and ρ_{min}, and the minimum VSWR, as shown in Fig. 3.
8. Calculate ρ_F and ρ'_B from equations (1) and (2)

$$\rho_F = \sqrt{\rho_{max}\,\rho_{min}} \qquad (1)$$

$$\rho'_B = \sqrt{\rho_{max}/\rho_{min}} \qquad (2)$$

where

ρ_F = the cable-to-rigid line VSWR associated with the input or front end connector under test.

Fig. 2. for the ation m method.

ρ'_B = the attenuated cable-to-rigid line VSWR associated with the output or back end connector under test, seen at the input.

If the attenuation of the cable is known, the cable-to-rigid line VSWR of the back end juncture can also be found by computing the back end reflection coefficient K_B from equation (3)

$$K_B = K_B' \epsilon \frac{\gamma l}{8.69} \qquad (3)$$

where

l = length of cable (in feet)

γ = attenuation of cable (in decibels per foot)

$$K'_B = \frac{1 - \rho'_B}{1 + \rho'_B}$$

and then the back end cable-to-rigid line VSWR, ρ_B, is found from equation (4)

$$\rho_B = \frac{1 + K_B}{1 - K_B} \qquad (4)$$

Illustrative Example:

Shown in Fig. 3 are sample measurement data taken at a nominal frequency of 3000Mc.

From the plotted data,

$$\rho_{max} = 1.15 \text{ and } \rho_{min} = 1.02$$

From equations (1) and (2)

$\rho_F = \sqrt{\rho_{max}\,\rho_{min}} = 1.08$ = cable-to-rigid line VSWR of the input connector.

$\rho'_B = \sqrt{\rho_{max}/\rho_{min}} = 1.065$ = cable-to-rigid line VSWR of the output connector seen at the input.

Since the attenuation of the cable is known ($\gamma = 0.18$db/ft.), ρ_B, the cable-to-rigid line VSWR of the back end, can be calculated.

$$K_B' = \frac{1 - \rho'_B}{1 + \rho'_B} = \frac{0.065}{2.065} = 0.0314$$

$$\therefore \quad K_B = 0.0314 \epsilon \frac{\gamma l}{8.69} = 0.0314 \epsilon \frac{0.18 \times 10}{8.69}$$

$$= 0.0314 \epsilon \times 0.207 = 0.0314 \times 1.23 = 0.0386$$

$$\therefore \quad \rho_B = \frac{1 + K_B}{1 - K_B} = \frac{1 + 0.0386}{1 - 0.0386} = 1.08$$

Variable-Short-Circuit Method

An alternate method of measuring the cable-to-rigid line VSWR is called the variable-short-circuit method[3] and is based on the conformal transformation of a variable reactance (such as a shorting plunger) on the end of a cable into a circle on the Smith Chart representing the input impedance. It has the advantage that less time is required in making the measurement, since the oscillator frequency does not have to be varied as in the frequency variation method (with corresponding adjustments of the load termination tuners). Furthermore, it does not require the assumption that the VSWR of the connector under test varies slowly with frequency.

The arrangement of equipment for the variable short circuit of cable-to-rigid line VSWR measurement is shown in Fig. 4. Except for the variable short circuit, the equipment is the conventional type used for making VSWR measurements described in Section 2.02, *Handbook*. Although the variable short circuit may be either coaxial or waveguide, for simplicity of illustration, the conventional waveguide non-contacting shorting plunger is indicated in Fig. 4. Details of non-contacting shorting plunger designs are presented in many places[4,5].

Follow this measurement procedure:

1. Arrange equipment as shown in Fig. 4 and follow the general warm-up and tuning procedures as indicated (Section 2.02, *Handbook*). Measure

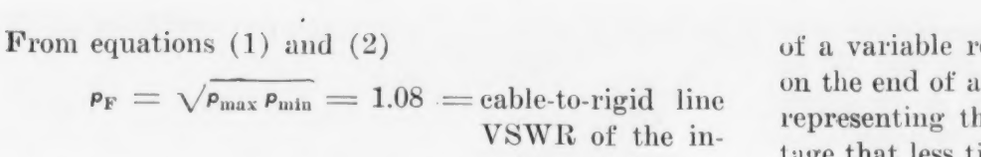


Fig. 1. A cable-to-rigid line connection.

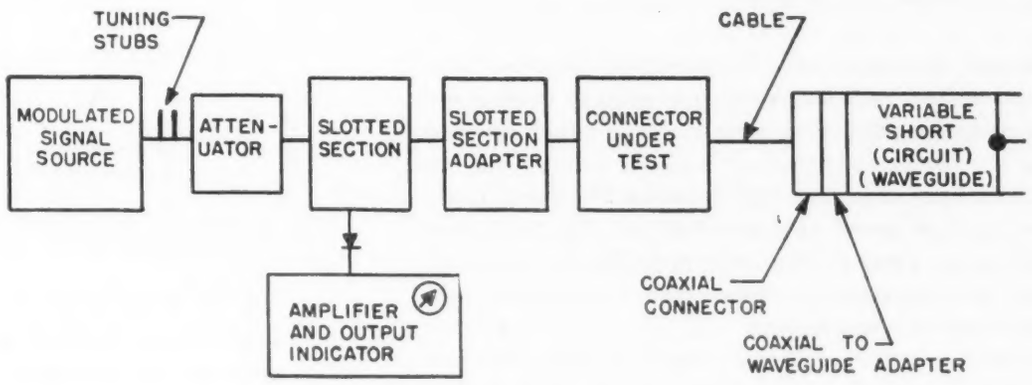


Fig. 2. Block diagram for the frequency-variation measurement method.

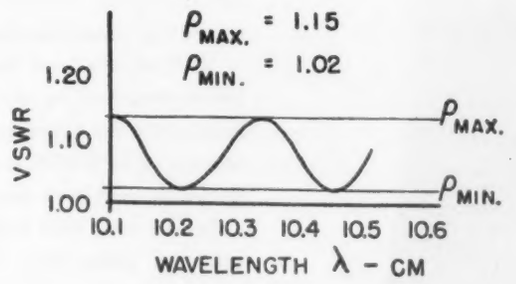


Fig. 3. A sample plot produced by the frequency-variation method.

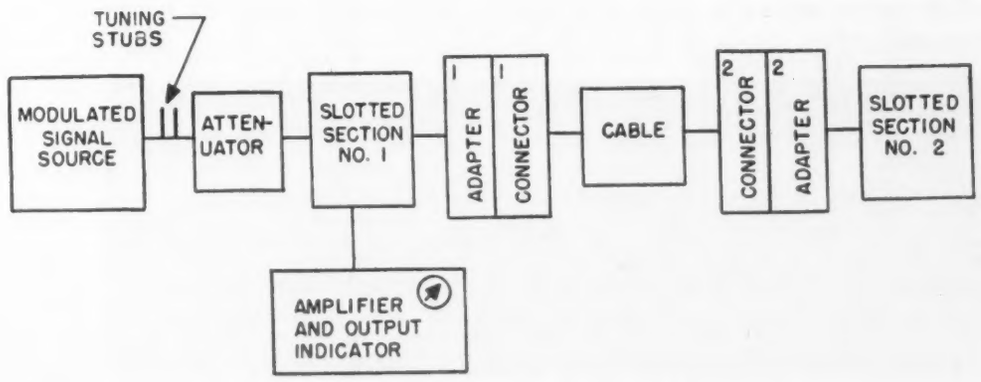


Fig. 4. The test arrangement for the variable-short-circuit method.

the frequency of the signal source. (See Section II, *Handbook,* for detailed procedures for the measurement of frequency and wavelength.)

2. Adjust the position of the variable shorting plunger until a maximum VSWR is measured in the slotted section. Record this value of VSWR, ρ_{max}, and the position of the minimum.
3. Adjust the variable short position until a minimum VSWR is measured in the slotted section. Record this value of VSWR, ρ_{min}, and the position of the minimum.

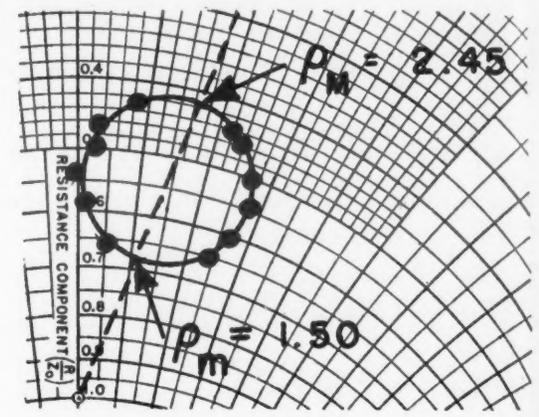


Fig. 5. A portion of a Smith chart showing a sample plot for determining ρ_{max} (ρ_M) and ρ_{min} (ρ_m).

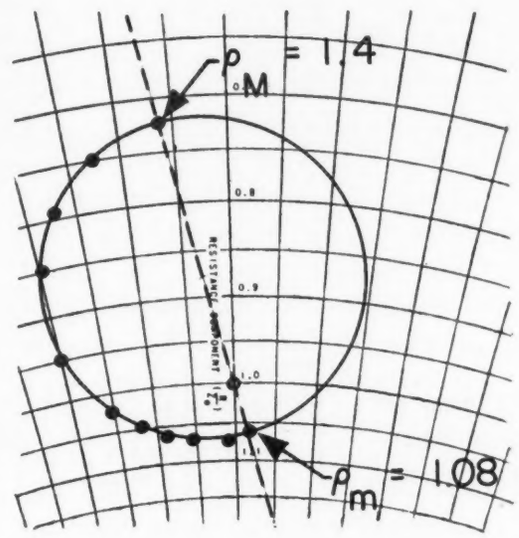


Fig. 6. A variation in the variable short circuit method produces this plot on an expanded portion of the center of the Smith chart.

In one case, if the position of the minimum for step (2) and step (3) are identical or separated by a multiple of one-half wavelength, the VSWR of the connector, ρ_{co}, located between the cable and slotted section is given by:

$$\rho_{co} = \sqrt{\rho_{max}\,\rho_{min}} \qquad (5)$$

In this case, the VSWR of the connector is greater than that measured at the input end of the cable. The VSWR value, ρ_{co}, corresponds to that measured in the slotted section with a match in the cable.

In a second case, if the position of the minimum for step (2) and step (3) above are separated by an odd multiple of one-quarter wavelength, the VSWR of the connector located between the cable and the slotted section is given by:

$$\rho_{co} = \sqrt{\rho_{max}/_{min}} \qquad (6)$$

In this case, the VSWR of the connector is less than that measured at the input end of the cable.

Illustrative Example

Shown in Figs. 5 and 6 are the results of plotting the VSWR and position of minimum as the short circuit at the output end of a cable is displaced. (The actual measurement procedure does not require the plotting of the data on a Smith Chart. It is included here to illustrate the circular locus of the reflection coefficient for the two cases discussed.) To obtain the high VSWR readings illustrated in Fig. 5, a mismatch was deliberately introduced in the connector under test by increasing the diameter of the inner contactor.

From the plot in Fig. 5

$\rho_{max} = 2.45$ and $\rho_{min} = 1.50$

therefore, from equation (5)

$$\rho_{co} = \sqrt{2.45 \times 1.50} = 1.92$$

From the plot in Fig. 6

$\rho_{max} = 1.4$ and $\rho_{min} = 1.08$

therefore, from equation (6)

$$\rho_{co} = \sqrt{1.4/1.08} = 1.14$$

References

1. Griemsmann, J.W.E., *Handbook of Design Data on Cable Connectors for Microwave Use,* Report No. R-158-47, PIB-107, Polytechnic Institute of Brooklyn. Prepared under Navy Bureau of Ships Contract NObs 28372, July, 1947.
2. Griemsmann, J.W.E., etal, *Radio Frequency Cable Corrector Measurements and Developments,* Polytechnic Institute of Brooklyn, Final Report R-219-49, PIB 163, Prepared under Navy Bureau of Ships Contract NObs 28372, July, 1947.
3. Griemsmann, J.W.E., Colton, Louis: *Variable Short Circuit Method for Measuring Cable-to-Rigid Line VSWR,* Polytechnic Institute of Brooklyn Research Report R-297-52, PIB-236 Prepared under Navy Bureau of Ships Contract NObs 52078.
4. Huggins, H. W.; "Broadband Non-Contacting Short Circuits For Coaxial Lines, Part I", *Proc. IRE:* pp 906-913, September, 1947.
5. Vogelman, J. H., *Precision Milli-Decibel Waveguide Attenuation Measurements,* Technical Report No. 6376, Electronic Development Division, Rome Air Development Center, ARDC, USAF, Griffis A.F. Base, Rome, New York, August, 1951.

Fig. 1. By using "Penny Size" components, the servomechanism system at the right was redesigned into the system on the left, which is only one-half as high.

Miniature Servomechanism Components

ONLY 3/4" in diameter, "Penny Size" servo motors and their components, two of which are shown in Fig. 2, feature increased accuracy over this firm's larger servomechanism components. Units available in this size for use in control systems include servo motors, synchro transmitters, control transformers, differentials, and resolvers.

Fig. 2. Featuring high accuracy, these miniature components have the same diameter as a penny.

An exam
sulting f
Fig. 1.

A subm
signed fo
in Fig. 2
not here
The amp
made by
Clifton,

"Penny
an integr
through
a maxim
torque o
input-pha
respectiv
with the
herent da
4000rpm

The sy
and diffe
10 minut
junction
and erro
measure

An int
the 3/4"
more in
to the

An example of weight-saving and size-reduction resulting from use of these components is shown in Fig. 1.

A subminiature servo amplifier, Type T3100, designed for use with these synchros is also shown in Fig. 2, left. Only the tubes in this amplifier are not hermetically sealed in a potting compound. The amplifier and the other components are all made by Kearfott Company, Inc., 1378 Main Ave., Clifton, N. J.

"Penny Size" components are constructed with an integral stator-housing assembly and a straight-through bore. The servo motor shown in Fig. 1 has a maximum no-load speed of 6500rpm, a stall torque of 0.1 in-oz, and a weight of 1.2 oz. The input-phase power and voltage are 1.5w and 18v, respectively. Another motor in this same size and with the same characteristics except for high inherent damping and a maximum no-load speed of 4000rpm is designed for simple instrument servos.

The synchro transmitters, control transformers, and differentials have maximum error limits of 10 minutes from electrical zero. For use in conjunction with the motors, they provide the sensors and error detectors of the servo loop. These units measure 3/4" diam x 1.658" long and weigh 1.75 oz.

An integral servo motor-damping generator in the 3/4" diameter size will be available soon. For more information on these components, turn to the Reader-Service Card and circle **ED-25.**

Universal Circuit Breadboard Chassis

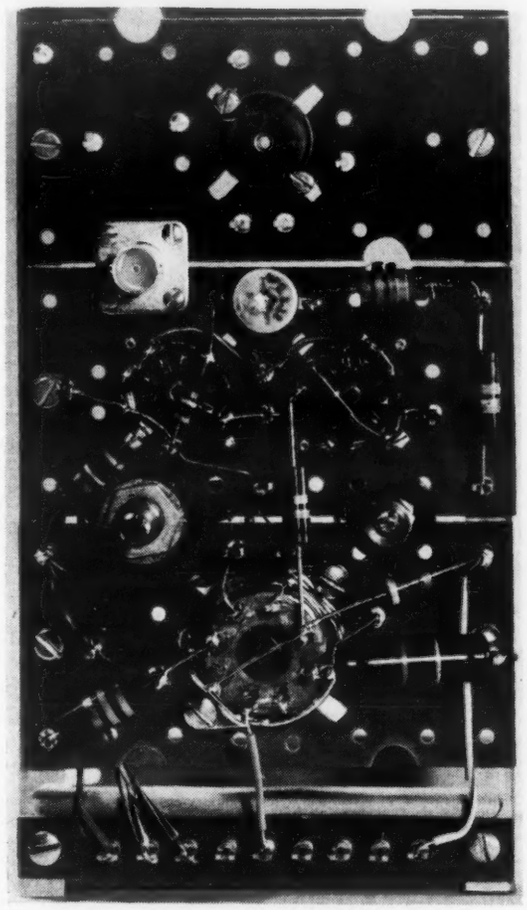


Fig. 1. Details of a prototype circuit constructed on the breadboard with various types of subchassis.

PROTOTYPE construction as well as printed wiring layouts are implemented by use of the Universal Circuit Breadboard Chassis shown in Fig. 3. A complete variety of components can be placed on the chassis without using a single power tool.

The units can be used individually, mounted side-by-side, or stacked, as shown in Fig. 4, enabling the designer to utilize them in the construction of large equipment prototypes of "modular" design. The chassis can also be mounted end-to-end. They are held together by 6-32 self-tapping screws.

Because the sub-chassis are made of phenolic, prototype printed-wired circuits can be drawn on their surfaces for experi-

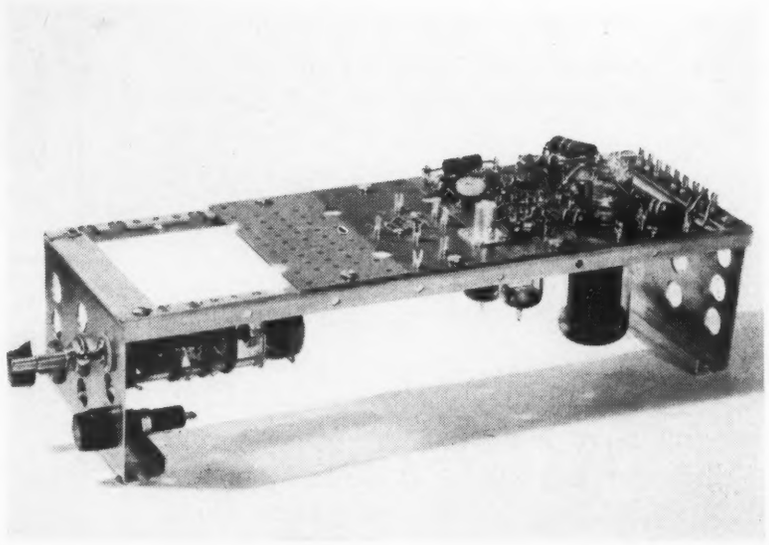


Fig. 2. A partially completed prototype.

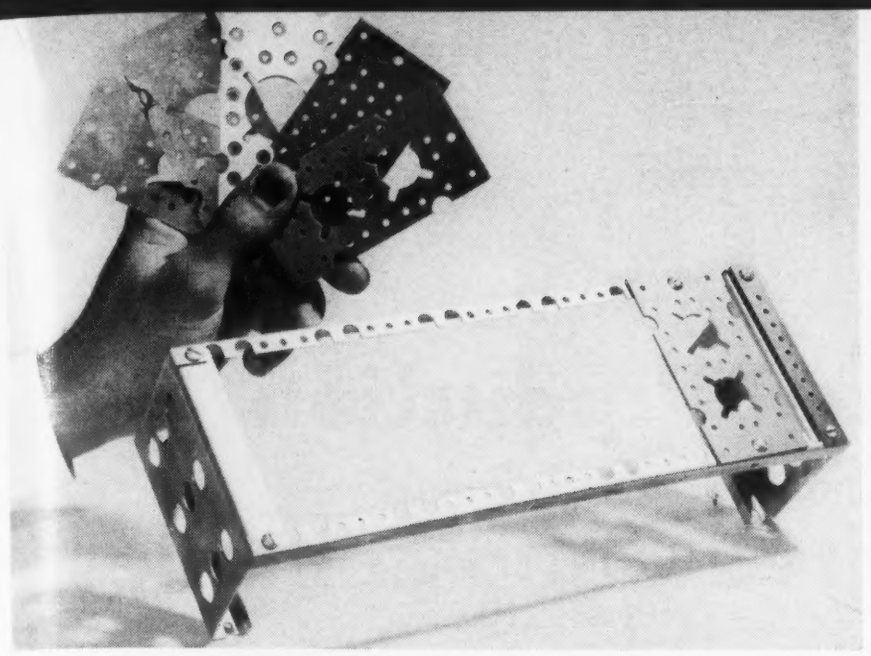
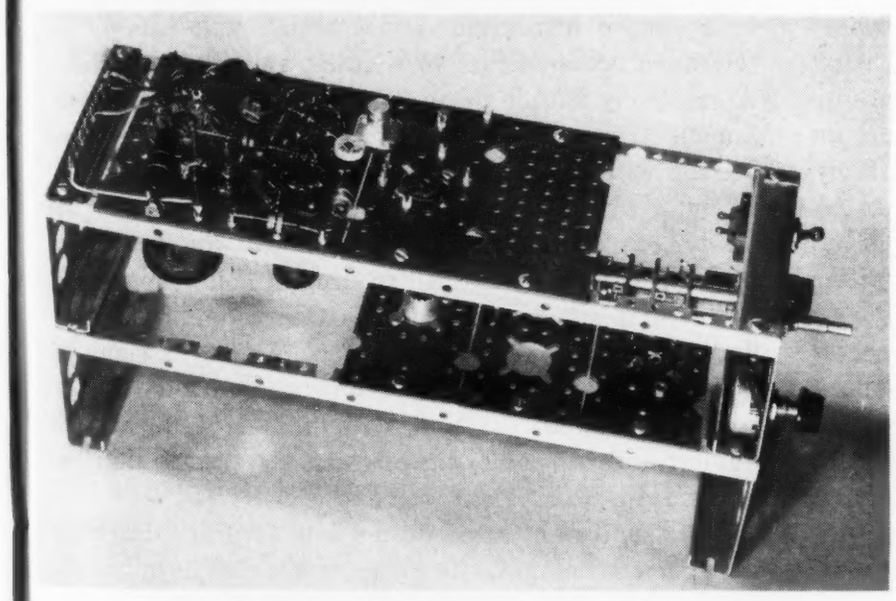


Fig. 3. The Universal Circuit Breadboard Chassis with its sub-chassis. The middle type has a metal ground overlay.

mentation. The sub-chassis come in four basic designs to accomodate various sizes of sockets. A terminal strip is also provided. The sub-chassis are also available with matching metal ground plane overlays to simulate metal chassis surfaces. One example of a sub-chassis with metal overlay for grounding is shown in Fig. 3.

The cadmium-plated chassis frame is 4″ wide x 12″ long x 3″ high. The end brackets of the frame have a series of 1/2″ holes to accommodate regular and miniature potentiometers, fuses and switches as shown in Figs. 2 and 4. The chassis are manufactured by Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J. For more information, turn to the Reader-Service Card and circle **ED-28.**



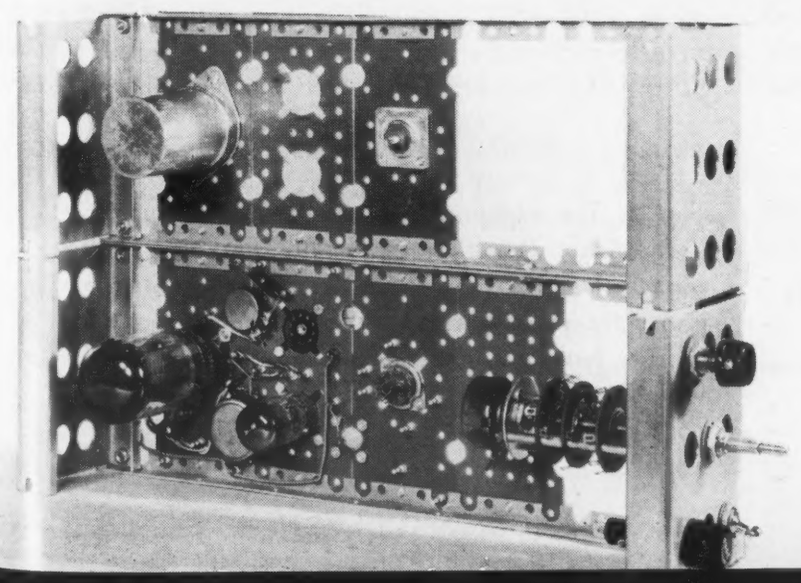


Fig. 4. Example of "stacked" and side-by-side arrangement of the breadboards in a modular construction. The units can also be mounted end-to-end.

Ideas for Design

Mechanized Production of Printed-Wired Subassemblies

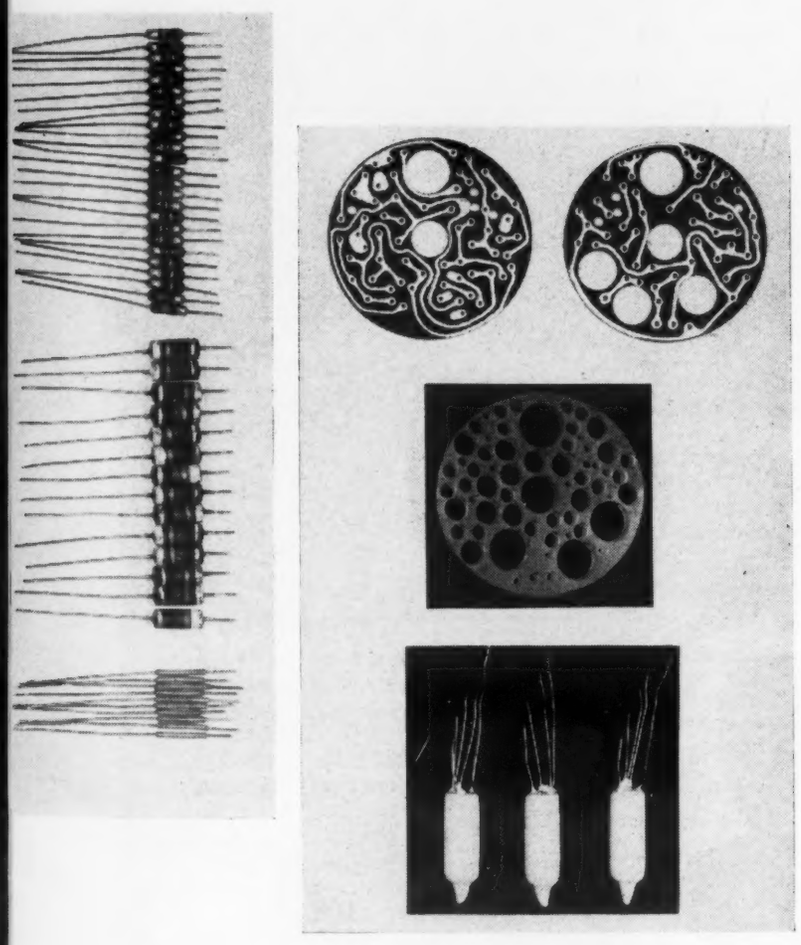


Fig. 1. Parts for the three-tube subassembly shown in Fig. 3. The "through wires" for interconnecting the two round printed-wire plates are at the bottom, left.

LOW-COST, rugged, compact electronic subassemblies utilizing printed wiring and standard components can be readily manufactured by the flexible, mechanized process described and illustrated on these pages. This production method was developed by James E. Huggins, Jr., Ordnance Corps, Frankford Arsenal, Philadelphia, Pa.

The completed "sandwich" assemblies, one of which is shown in Fig. 3, can incorporate much more complex circuitry than the familiar "two-dimensional" printed-wiring board because two printed-wiring plates are used, one at the bottom and one at the top.

Design changes are readily accomplished and do not call for any modification of the basic assembly equipment shown in Fig. 2. Service problems are reduced to disposing of the entire unit because of its low cost. In addition, the assembly has all the familiar advantages of printed wiring.

The components and hardware used in this process are shown in Fig. 1. The through wires that are used to interconnect the two printed-wiring plates have a sleeved portion that prevents the wire from slipping through the plate hole after assembly. The component leads do not have to be unduly straight and are clipped short at only one end. The assembly procedures are illustrated in Figs. 4 to 9.

After dip-soldering, the leads are clipped flush against the plate, as shown in Fig. 3. The three subminiature tubes are manually inserted in the remaining plate and the same dip-soldering procedures followed to complete the unit.

This design and assembly method will lend itself quite simply and economically to fully automatic production. Hopper feeding of components from bulk will prove easy, since the component leads are left straight rather than being preformed. An individual hopper or vibratory elevator feeder will be used for each component. The feeder will place the component in a simple inspection device which will carry "intolerance" components to a stack awaiting assembly. A relatively simple device will be used to trip a component from each stack simultaneously. Each component will be tripped into a tube which will convey it by gravity to a central master catacomb. This master catacomb will be located above the automatic assembling mechanism. All feeding of components will be accomplished by gravity. Components will be dropped from the master catacomb and assembled into the final unit, as previously described. After being assembled, the unit will be conveyed through fluxing and dip-soldering operations, after which the excess leads will be cut.

The "sandwich" type design has several additional welcome advantages. Components are rigidly mounted between the two plates and the unit is quite rugged when completed, even without a catacomb. Component leads require no sleeving. The design and method of assembly are flexible in that no machinery changes

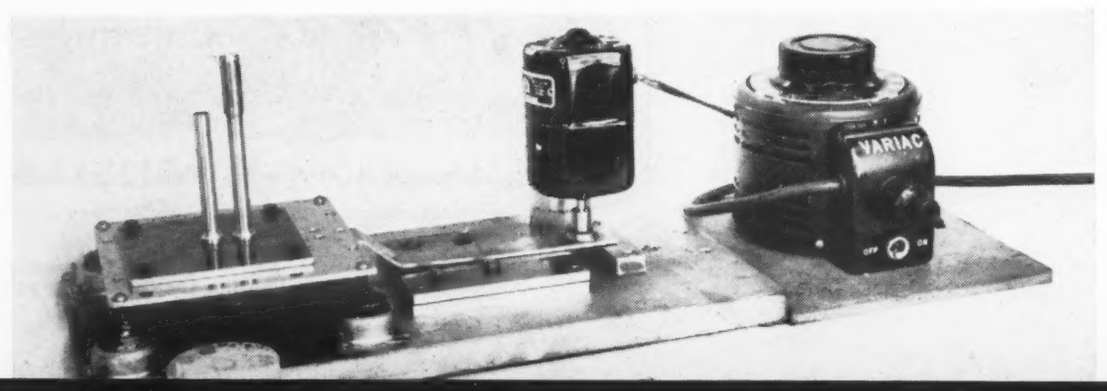


Fig. 2. The equipment required for producing a "sandwich". The pilot catacomb, pin No. 2, and pin No. 1 are in the foreground. The pilot catacomb is exactly like the assembly's catacomb except for greater length. The variac and motor provide the vibrations necessary to shake the components into position.

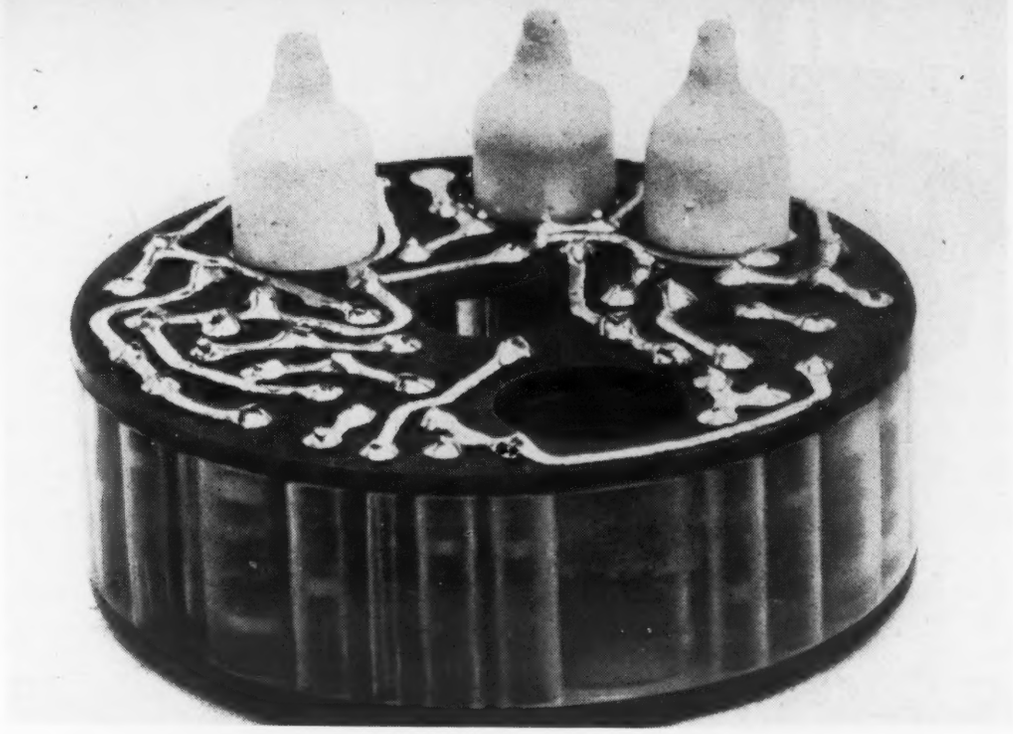


Fig. 3. A completed printed-wired "sandwich" subassembly.

are required to change from one size of component body to another. Components of widely varying lengths and diameters may be handled with equal ease because catacombs can be made any size, and at relatively low cost once the die is made. For that matter, catacombs are not required: a removable-type catacomb can be designed and used if one desires to build units without a catacomb. Furthermore, there is the natural advantage of the ease of circuitry change simply by changing the master circuit print. One of the main advantages of this method of assembly is that close tolerances are not required.

Complex electronic equipment can be subdivided into small units which can be designed and assembled in this manner. These units would be disposable when found to be faulty in the field and would help decrease costly trouble shooting. Repair of the unit after failure from use is rather difficult and, as such, uneconomical. Repair during manufacture would be unnecessary, with adequate inspection of components and controlled manufacturing processes, as a result of the virtual elimination of human error.

The method described herein will result in large savings because of the decreased manual labor required. Further advantages lie in the fact that automatic machinery for this method will be relatively inexpensive and flexible. Less indirect labor is required because component leads are not formed, sleeving is not required, and component inspection can be readily accomplished.

Demands for cost and size reductions are forcing the design engineer to consider the final physical form in the earliest stages of the development of a new product, perhaps even before the circuit is conceived. Exciting new production techniques rather than advances in circuitry may lead to the solution of many of these problems. The electronic design engineer must now include a knowledge of production systems like printed-wired "sandwich" construction in the tools of his trade.

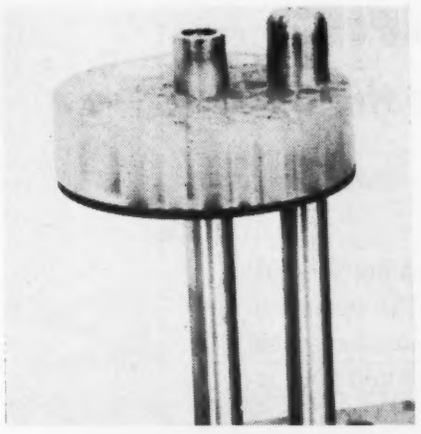


Fig. 4. The first stage in the assembly procedure after pin No. 1, a plate, and the catacomb have been positioned on the shafts with the proper holes in line.

Fig. 5. Hand loading of components begins after the pilot catacomb has been placed over the catacomb.

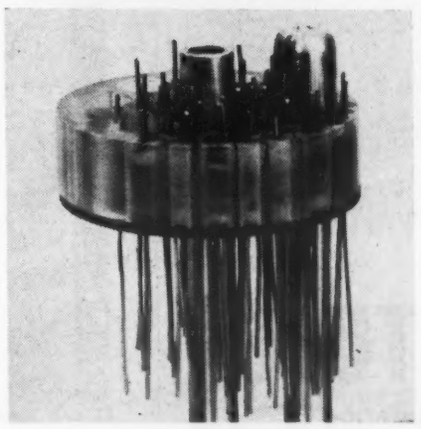


Fig. 6. The components have been vibrated into position and the pilot catacomb has been removed.

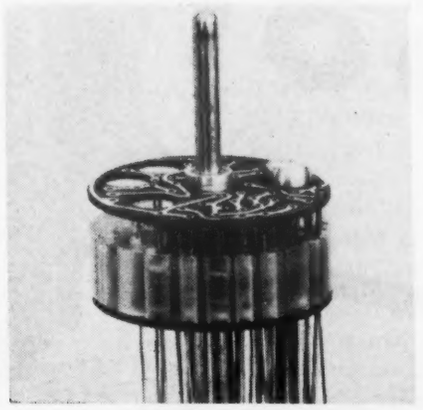


Fig. 7. The top printed-wire plate has been added and pin No. 2 has been threaded into pin No. 1.

Fig. 8. The catacomb is moved flush against the top plate prior to inverting the assembly.

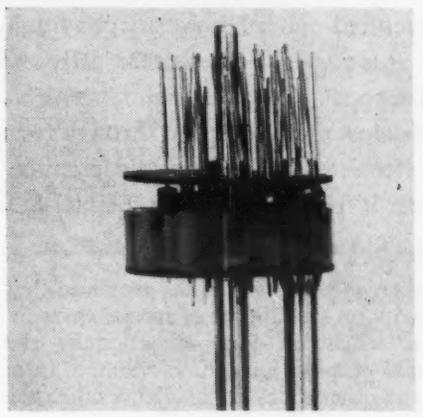


Fig. 9. The assembly has been inverted and replaced on the shafts. Some of the component leads have already slipped through their holes in the plate. Vibrations will now shake the other leads into place.

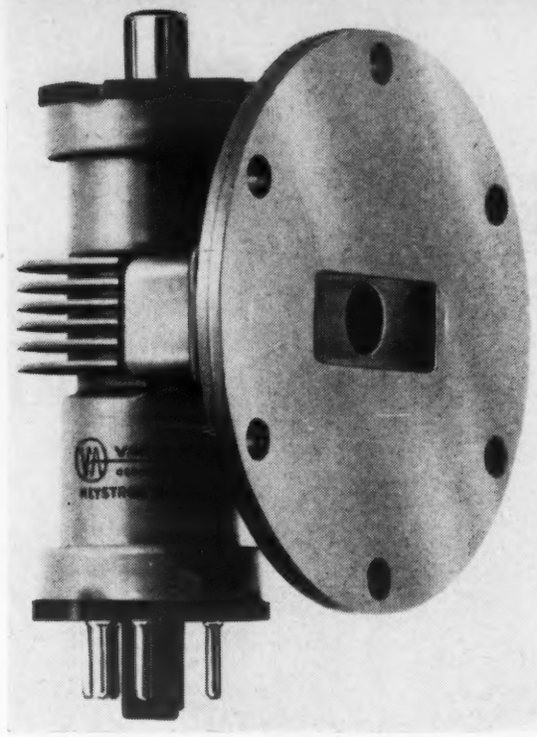
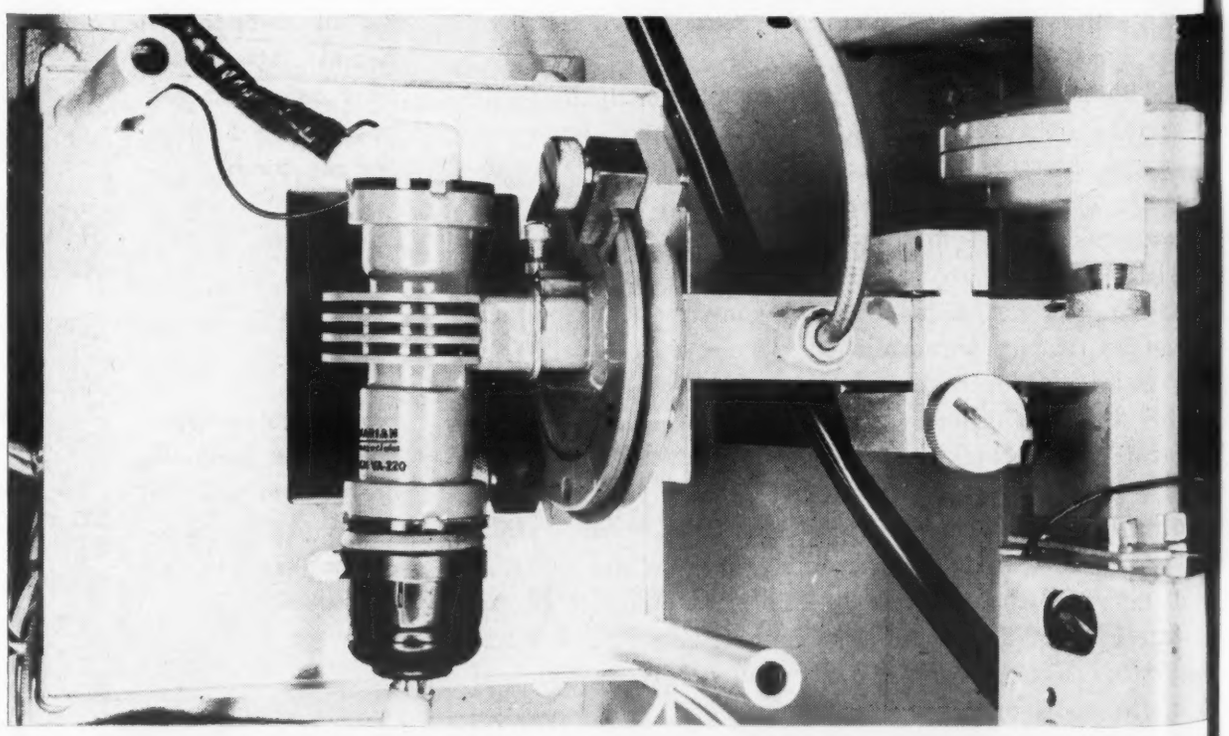


Fig. 1. One of the VA-220 Series Relay Klystrons, which are available in five frequency ranges.

Relay Klystron

FEATURING negligible frequency drift, easier tuning and ample power to override noise, the long-life VA-220 Series Relay Klystrons offer significant advantages for all relay applications in the 6000-8000Mc band. Inherent noise and f-m distortion is 60db below a 1Mc deviation. In addition, the tubes, one of which is shown in Fig. 1, are offered at half the cost of this firm's earlier klystrons of comparable performance.

Fig. 2. A klystron in a modern relay system.



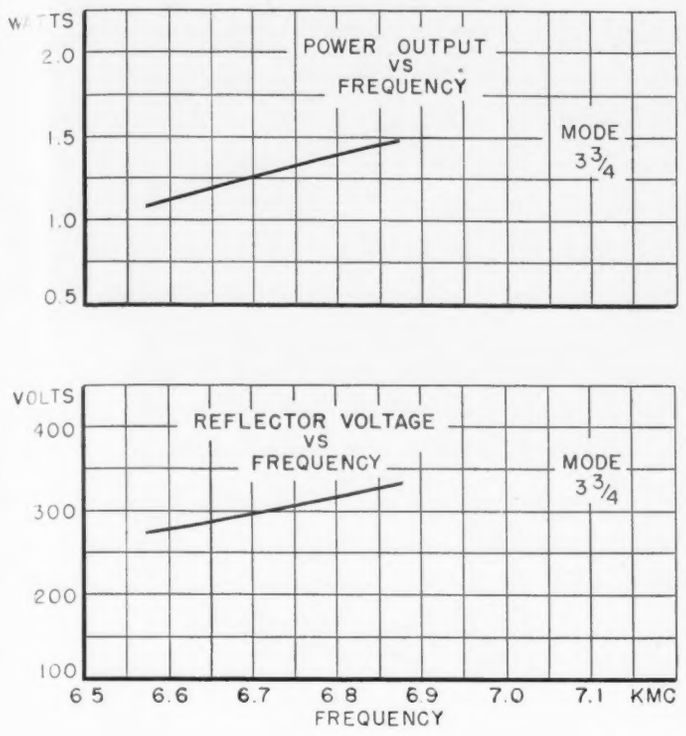


Fig. 3. Two characteristics of the Type D tube.

Various characteristics of these klystrons are given in the accompanying curves. Typical operation of one of the units calls for a resonator voltage of 750v for a power output of 1.2w, a bandwidth of 35Mc, and a modulation sensitivity of 375kc/v. Reflector capacity is 6mmfd maximum. Frequency ranges for the various models in the VA-220 Series are: Type F, 5925-6225Mc; Type E, 6225-6525Mc; Type D, 6575-6875Mc; Type C, 6875-7125Mc; and Type B, 7125-7425Mc.

Life expectancy of the tubes is 10,000 hr, and they are guaranteed for 2000 hr of operation. Forced air cooling of 30cfm is required for the units, which are manufactured by Varian Associates, 611 Hansen Way, Palo Alto, Calif. Dimensions of the tubes are 2.375″ x 3.75″ x 3.19″. The output connection mates with a UG-343/U choke. The tubes do not have any modulation anomalies.

The units may be operated in any position. The base is the small wafer octal type, and they have a signal-screw tuner. For more data on these tubes, turn to the Reader-Service Card and circle **ED-31.**

Fig. 1. Attenuation in decibels is read directly at the window in the Type 30 Precision Attenuator.

DESIGNATED the Type 30 Precision Attenuator, a continuously variable attenuator of the piston type featuring high accuracy, rugged construction and a direct-reading counter-type attenuation indicator is shown in Fig. 1. Attenuation is set to the desired value by the knob and is read from the indicator in tenths of a decibel without the necessity for interpolation.

The standard model has input and output coils tuned to a center frequency of 30Mc, and is intended for use over the range from 25 to 35Mc. Damping resistors in the standard model provide input and output impedances of 50 ohms. The unit has an attenuation range of 80db above a minimum insertion loss of 25db (at 30Mc). Actual attenuation above minimum insertion loss is within ±0.2db of the value indicated by the counter at any frequency from 25 to 35Mc. Input and output connections of 1/5 ohm impedance are provided by panel-mounted BNC connectors.

Fig. 2 is a view of the attenuator proper without the case. The body of the attenuator consists of a casting that houses the fixed input coils and pro-

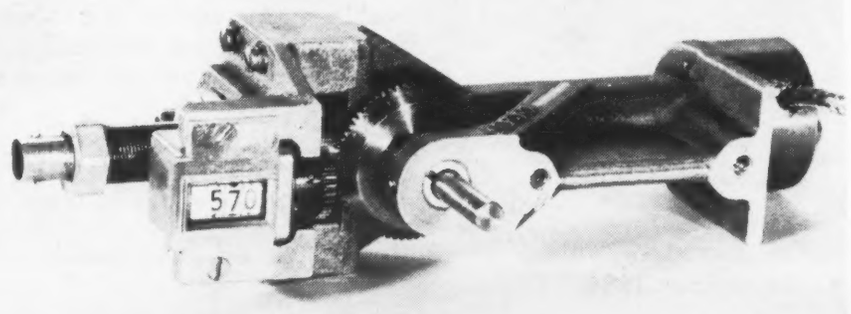


Fig. 2. The rugged construction of the unit is apparent when it is removed from its case.

Precision Attenuator

vides the cylindrical attenuation chamber in which a piston carries the movable output coil. The rugged construction of the attenuator assures maximum long-term calibration accuracy and freedom from adverse effects of shock and vibration.

The fluted control knob drives the attenuator piston through a pair of stainless-steel bevel gears. The drive gear is internally threaded, thus acting as a driving nut for the internally threaded piston. This bevel gear is of the split, spring-loaded type to prevent play between the gear and the piston while still allowing the unit to operate smoothly and easily.

The shaft of the counter indicator is driven by a pinion from a second set of teeth on the split bevel gear, so that the counter gives a true indication of piston position without the effects of play or backlash. A set of piston rings prevents signal leakage past the end of the piston. Accuracy is maintained over the full attenuation range.

The Type 30 Attenuator is manufactured by Airborne Instruments Laboratory, Inc., 160 Old Country Rd., Mineola, N. Y. Housed in a walnut case for laboratory use, it is also available without case or panel for use as a component of more complex test equipment. In the case the attenuator measures 11″ long x 4″ wide x 3-3/4″ high and weighs 3-1/4 lb. On special order, the attenuator can be supplied with input and output impedances other than 50 ohms and for use in other than the standard frequency range. For more information on this useful laboratory instrument, turn to the Reader-Service Card and circle **ED-34.**

Design Forum

Mobile "Master" Computer

DYSEAC, the mobile digital computer illustrated on these pages, can function as a computer by itself or serve as the "master computer" in a complex data-processing network in which it controls other digital computers or is controlled in turn by them. The instrument has extreme versatility of control and great latitude for expansion. While serving as a valuable scientific aid, it can also be the proving ground for evaluating certain novel control features and component packaging techniques. It was developed by the Electronic Computers Laboratory of the National Bureau of Standards, Washington 25, D. C.

At first glance the most striking feature of the instrument is its mobility. It is mounted in two standard 40-foot trailers. The control console, magnetic-wire input-output gear, computer, memory, and a 12-ton capacity air conditioner are in one trailer. The second van houses regulated d-c power supplies, some of the special instruments that may be connected to the computer, and provides a work area as well as storage space. Where standard 3-phase, 208v power is not available, a third vehicle will carry two 50kva alternators to power the computer. Since DYSEAC requires a minimum of 55kva, enough power is available from the mobile power plant to operate associated devices, thus making up a completely self-contained computer center.

When serving as the nucleus of a data-processing system, DYSEAC can solve problems fed directly to it, while simultaneously aiding remote external devices on other problems and sharing its memory with them. It can regulate the speed of its own computations to match those of "annexed" external computers, or interrupt its own computations entirely and devote itself to the external situation or new special problems. Among the devices that can be attached to the computer are those that store, tabulate, file, convert, display and sense information. Communication between DYSEAC and the external instruments can take place at any time, on a completely unscheduled basis, and in both directions at once.

As a consequence, supervisory control over the common problem may initially be loosely distributed throughout the system, and then temporarily concentrated in one computer, or even passed rapidly from one machine to another as the need arises. The special joint-control properties of DYSEAC could not be secured satisfactorily by the use of program-

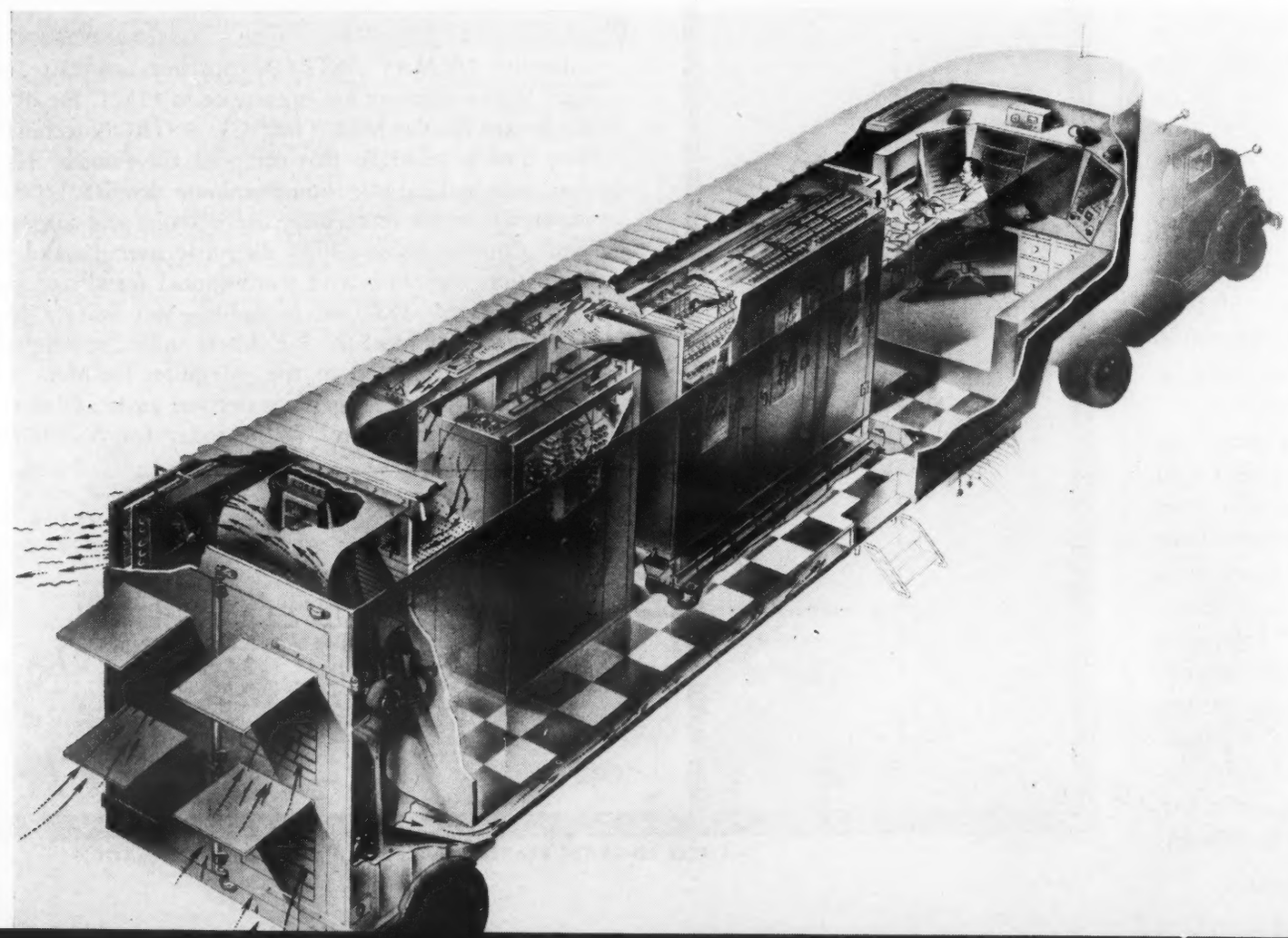


Fig. 1. One of the trailers housing (from left to right) the air-conditioning unit, memory, computer, control console, and input-output gear. The trailer has a false floor underneath which cooling air is carried as indicated by the arrows.

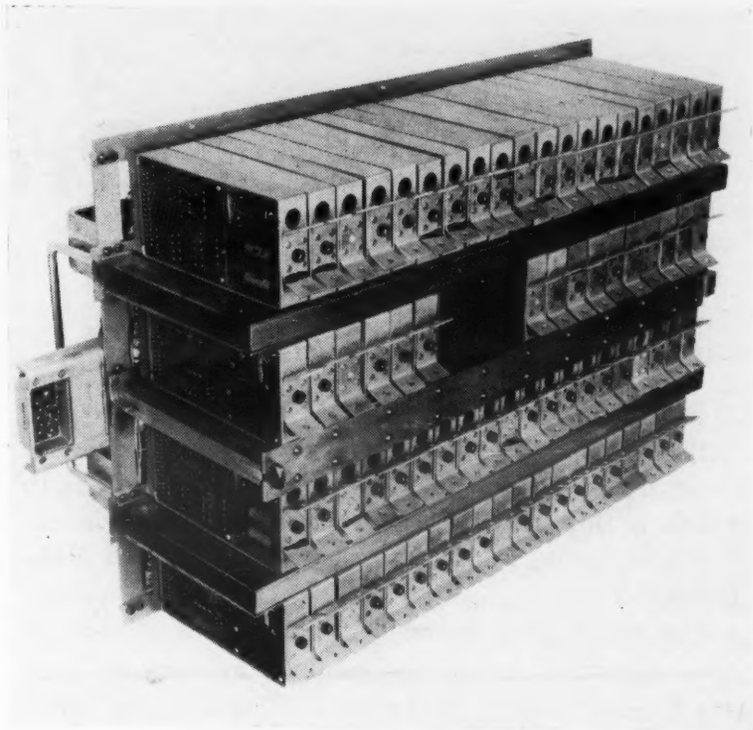


Fig. 2. There are three racks like this one supporting 80 plug-in circuit packages each.

ming procedures alone, but required new techniques.

Only two types of etched-circuit plug-in packages are required as basic building blocks in DYSEAC. These modular units are assembled in groups of 80 on three racks, one of which is shown in Fig. 2. One modular unit, consisting of an amplifier tube, a pulse transformer, and a number of diodes, is adaptable with minor changes to the majority of circuit needs. This unit serves as a low-impedance pulse driver, a flip-flop, and for a number of gating functions. A second type of package houses delay lines used for interconnection between the stages. The 524 tube packages and 251 delay-line packages, containing 21,000 diodes and 3800 1/4μsec delay-line segments constitute about 90% of the total circuit requirements of the computer exclusive of the acoustic memory and the input-output equipment. The racks, as well as the memory cabinet, are shock-mounted for protection while moving.

In designing DYSEAC, provision was made for expanding the high-speed storage from an initial capacity of 512 words up to a total capacity of 4096 words. The memory consists of 64 mercury acoustic delay line packages, one of which is shown in Fig. 4. This expansion is most significant, since the computer is organized around the memory unit. The memory has a normal 1Mc internal repetition rate.

The unusual control features of DYSEAC combined with its mobility represent an ingenious solution to the problem of setting up a data-processing network. At the same time, this computer is testing new construction methods. If DYSEAC is successful in demonstrating the feasibility of harnessing together a number of data-processing devices, including computers, it can help in the establishment of a standard method of feeding data to computers. Such a standard method, like the binary code employed in DYSEAC, combined with the joint control features, would multiply the total computation capacity of the nation's computers. The design of DYSEAC has implemented the concept of the "master computer" a stimulating idea for all designers of computers.

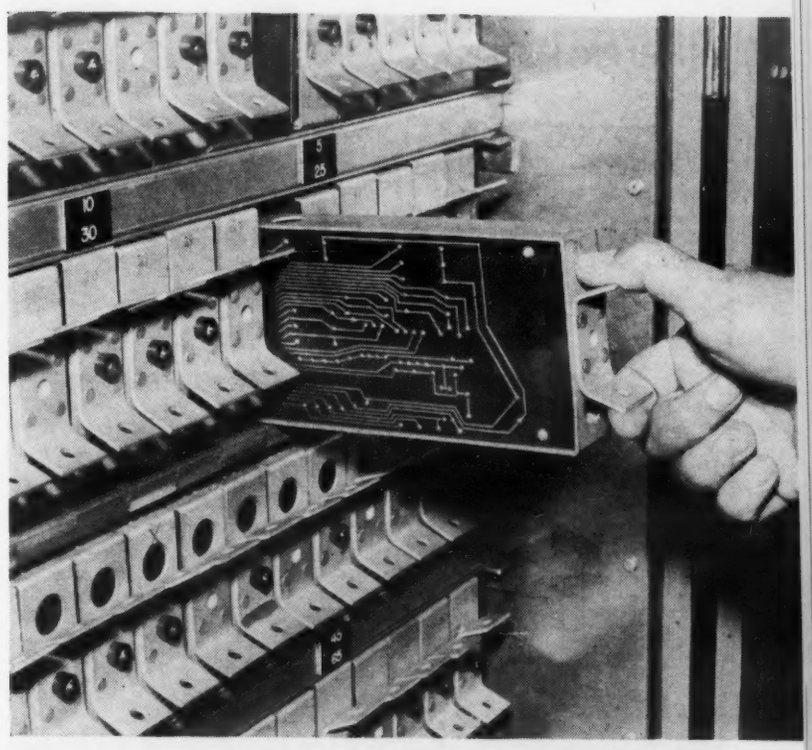


Fig. 3. The printed-wired circuit packages are quickly removed from the racks for servicing.

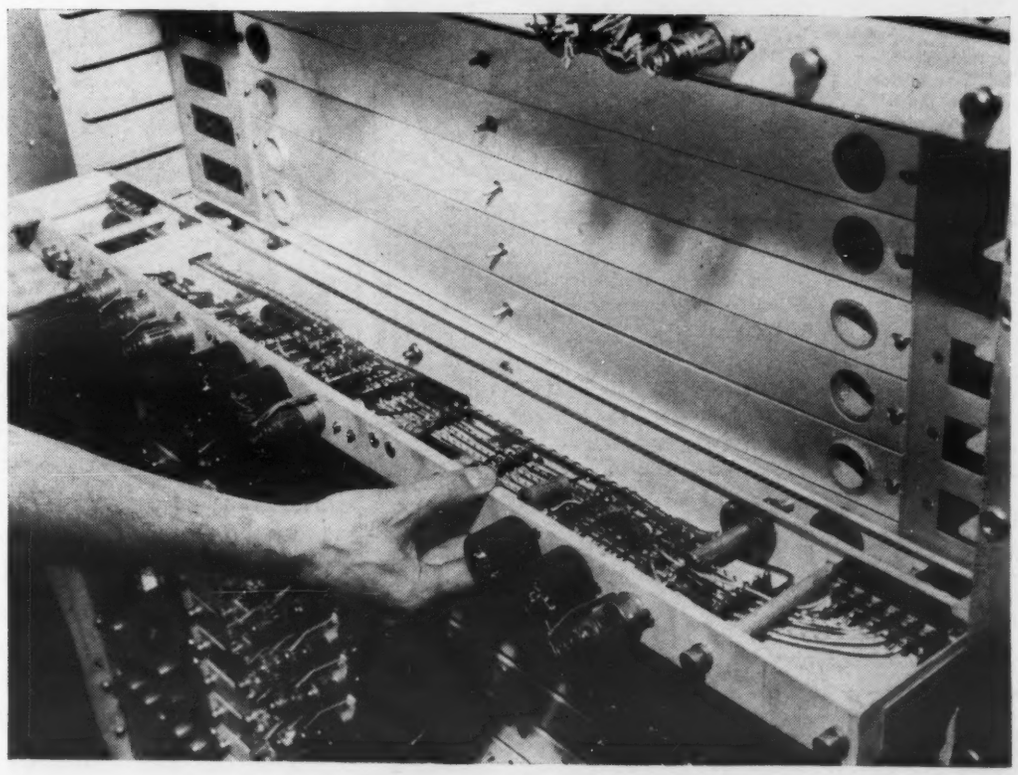


Fig. 4. One stage of the acoustic delay line memory is being removed for servicing by an operator. These stages are shock-mounted for protection while the trailer is being moved.

New Products . . .

Miniature Resistor

Surpasses MIL-R-10683A

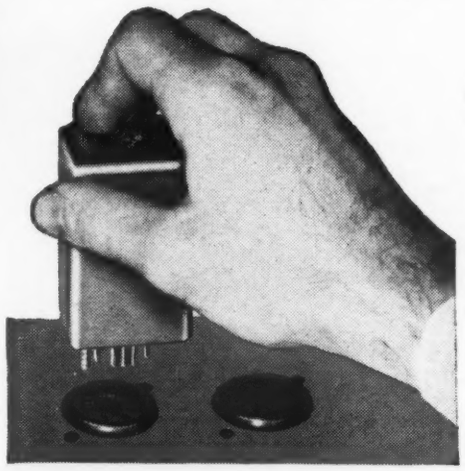
The Type HFR 1/4w high-frequency miniature resistor is constructed of special solid ceramic rods to which a thin resistive film is permanently bonded. Featuring axial leads, it surpasses specification MIL-R-10683A.

The entire body assembly, including lead caps, is coated with a moisture-resistant protective coating especially designed for high frequency application. The unit is recommended for use in circuits requiring excellent frequency response over a wide band of frequencies and where low shunt capacity is desirable. Standard tolerance is ±20%, with ±10% and ±5% available. Body length is 9/16″; body diameter (over caps) 3/32″, lead length 1-1/2″, and lead diameter 0.025″. International Resistance Co., Dept. ED, 401 North Broad St., Philadelphia 8, Pa.

CIRCLE ED-37 ON READER-SERVICE CARD FOR MORE INFORMATION

Time Delay Relay

Plug-In Type



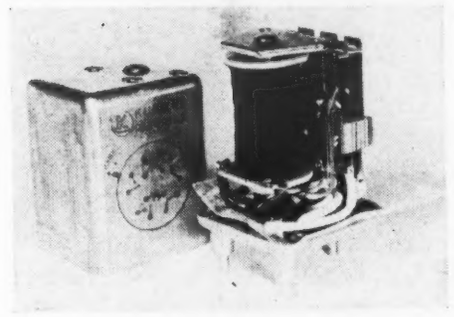
The type F "Silic-O-Netic" plug-in Time Delay Relay operates on the hydraulic-magnetic silicone operating principle. These compact, lightweight units are hermetically sealed against dust and moisture with an inert-gas fill optionally available. The relay is provided with standard time delays from 1/4 to 120 sec.

These relays are furnished with either octal-pin or solder-lug terminals for operation on 24v to 220v, a-c, or 12v to 125v, d-c. Contact capacity is 3amp at 120v, a-c, or lamp at 50v, d-c, with spst through dpdt switching actions available. Heinemann Electric Co., Dept. ED, 449 Plum St., Trenton 2, N.J.

CIRCLE ED-38 ON READER-SERVICE CARD FOR MORE INFORMATION

Telephone Relays

With up to 12 Contact Springs



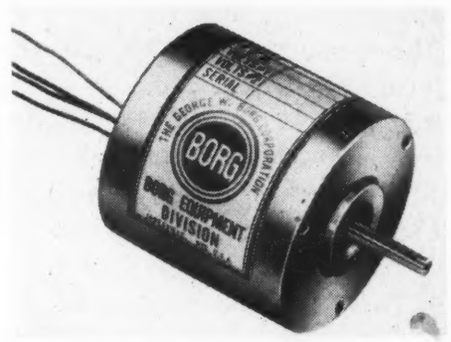
The Series 5M relay incorporates all of the features of this firm's Series M relay, plus the additional features of: up to 12 contact springs (forms A to C); hermetically sealed construction; 7, 9 and 14 pin "plug-in" header; nitrogen filling; and ability to withstand 75g shock test. It is intended for use in all equipment where adverse climatic or environmental conditions exist.

The relay measures 2-11/16″ x 1-5/8″ x 1-13/32″ overall. The hermetic sealing simplifies maintenance and renders the relay tamper-proof. The dry nitrogen gas produces high sparking potential or arc suppression. Hundreds of coil and contact combinations are available, and numerous additional features are available for special applications. Kurman Electric Co., Dept. ED, 35-18 37th Street, Long Island City 1, N. Y.

CIRCLE ED-39 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Motor

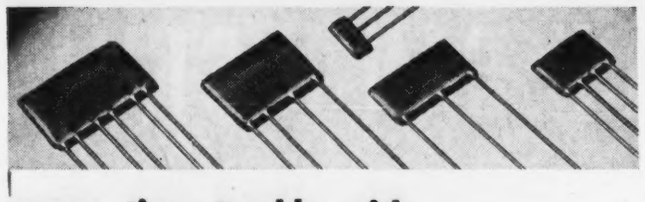
Precision Miniature Design



The Model 1050 Servo Control Motor, was specifically designed to operate this firm's "Micropots", but can be used in many other servo applications or where a precision, high-quality motor is desired. A compact unit, it has three threaded holes in the housing for mounting the motor on a panel. Approximate dimensions are 1-1/2″ diam x 1-1/2″ long, with a 1/2″ shaft extension.

Minimum locked rotor torque is 0.82 oz-in in either direction when operated at 115v. Other characteristics are: induction type, 2-phase, 115v, 400cy, 5500rpm no-load speed. Borg Equipment Division, The George W. Borg Corporation, Dept. ED, Janesville, Wis.

CIRCLE ED-40 ON READER-SERVICE CARD FOR MORE INFORMATION



save money, time, trouble, with

Bulplate® Printed Circuits and Multiple Capacitors

With Sprague Bulplates, you have fewer parts to purchase, inspect, handle, and stock . . . fewer soldering operations, faster assembly with less chance of wiring errors. They're more compact, lighter in weight, and Bulplates frequently cost less than the conventional components they replace.

Bulplate *Multiple Capacitors* with integral connecting circuitry are available in both general application and temperature compensating ceramic bodies. Bulplate *Printed Circuits* have highly stable resistor elements added to the capacitor elements of Bulplate Multiple Capacitors. In addition to the many standard designs shown in Engineering Bulletins 600 and 650C, Sprague will engineer specials to fit your needs.

SPRAGUE ELECTRIC COMPANY

347 Marshall Street
North Adams, Mass.

SPRAGUE

CIRCLE ED-41 ON READER-SERVICE CARD FOR MORE INFORMATION

Designed for portability and low-cost as well as accuracy, the newly developed DS-660 will count and display any electrical or mechanical event which can be converted into a varying voltage of sufficient amptitude — from 10 to 100,000 events per second. Derives its time base from the 60 cycle line — which determines the accuracy — approximately .1%. Here is new and amazing reliability and circuitry available in one unit.

FEATURES:

- SELF CHECKING
- AUTOMATIC and MANUAL RESET
- DISPLAY from 1 to 10 SECONDS
- LIGHTWEIGHT — only 16 lbs.
- UTILIZES STANDARD PLUG-IN DECADES
- BASIC UNIT READS OUT TO 10 KC (4 decades)
- AIR COOLED (Fan)

Write TODAY for full technical information

THE Detectron CORPORATION, Dept. 76-A
5420 VINELAND AVE., NO. HOLLYWOOD, CALIF.

CIRCLE ED-42 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Potentiometers

Standard 3-Turn Design

The "Series 930 Micropots" are standard 3-turn precision potentiometers designed to provide great flexibility of application. Either or both mechanical stops may be used as phasing points due to the adjustability of the contact drive assembly. This feature also provides greater accuracy in the four basic types of linearity without modification of the potentiometer.

Low starting and running torques make it possible to use these 3-turn units in lieu of single-turn pots and thereby gain greater accuracy and resolution. They are available in standard models from one to five-gang. Each model is produced with single-ended or double-ended shaft and with servo or bushing mount at either or both ends.

Additional advantages include extra-long life due to automatic compensation contact wear and the scanning action of the bar contact; no backlash between mechanical rotation and electrical rotation; finer resolution due to a longer Kohlrausch winding; welded terminal leads; and a plastic housing that embeds resistance element, lead wires, and terminals into a rigid, well-insulated assembly. Borg Equipment Division, The George W. Borg Corp., Dept. ED, Janesville, Wisc.

CIRCLE ED-43 ON READER-SERVICE CARD FOR MORE INFORMATION

Flashlight Battery

Features No Corrosive Leakage

The danger of damaging expensive laboratory equipment due to the leakage of corrosive matter from their worn-out batteries can be avoided by using the "Eveready" D99 flashlight battery. In this battery the carbon electrode is on the outside, and the zinc electrode is on the inside.

The insert carbon wall keeps the battery sealed even when the zinc is consumed and the battery is exhausted. This leakproof battery will not swell. The construction also provides efficient consumption of the zinc, and, therefore, means a longer life. National Carbon Co., Dept. ED, 30 East 42nd St., New York 17, N. Y.

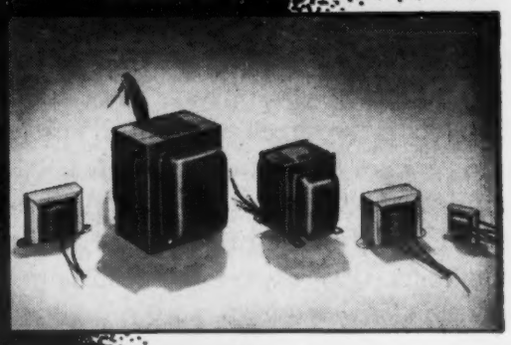
CIRCLE ED-44 ON READER-SERVICE CARD FOR MORE INFORMATION

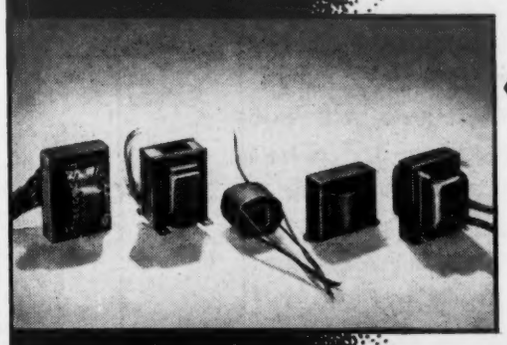
TRANSFORMERS . . .

. . . specified for the usual
. . . demanded for the unusual

GTC

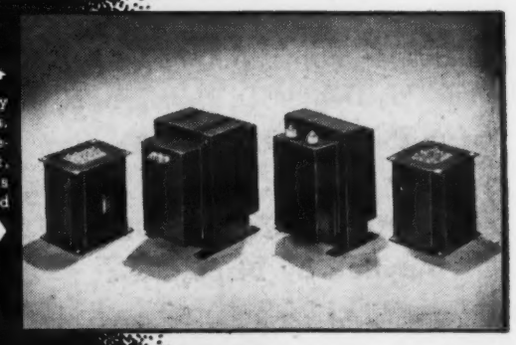
"GTC" Transformers for television receiver applications . . . custom designed for high quality at minimum cost.

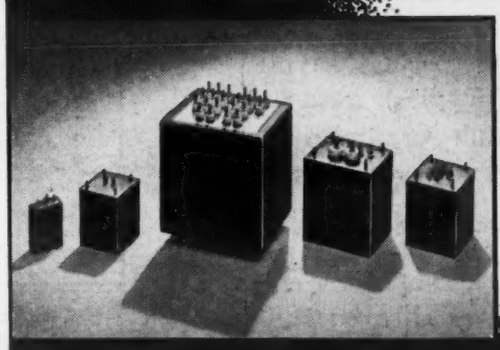




"GTC" Transformers for industrial and commercial applications . . . accurately engineered and fully recognized for finest quality.

Manufacturers specify "GTC" . . . for audio uses, communication, radar devices, test equipment, transmitters, and various other electronic-controlled devices.





"GTC" Military Transformers . . . designed to meet rigid government specifications and to perform under the most severe and continuous operating conditions. MIL-T-27 and JAN-T-27.

Skilled engineering techniques make GTC a source for transformers in highly specialized and extremely unusual applications. Utilization of these techniques results in greater dependability, quality and better construction.

Our completely self-contained plant's modern equipment guarantees transformer production in any quantity, to meet your requirements. We welcome your inquiry and will supply production samples where desired.

GTC

GENERAL TRANSFORMER COMPANY

serving industry since 1928

18240 Harwood Avenue, Homewood, Illinois
(Suburb of Chicago)

CIRCLE ED-46 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products...

Blueprint Pencil

Eight Colors Available

A new blueprint pencil specifically designed for checking and marking on all blue or white prints and coarse tooth papers is resistant to oil, dirt, and grime and also unaffected by sunlight or moisture. The lead does not reflect light and results in opaque markings that give excellent reproductions without ghosts.

The specially formulated lead gives brilliant, insoluable, contrasting color markings. The pencil can be sharpened to a fine point and will not powder or smudge. They are marketed in an 8-color pack including a special obliterating blue pencil for eliminating white marks on blueprints. Colors are green, yellow, red, vermillion, light blue, dark blue, white, and black. A sample pencil is available on request. American Lead Pencil Co., Dept. ED, Hoboken, N. J.

CIRCLE ED-47 ON READER-SERVICE CARD

Lubricating Coatings

Applied by Dispersions

Two new "dag" dispersions can be used to coat all types of surfaces with dry lubricating coatings having epoxy resin bases. Typical uses for these products include dry lubricating films for high-temperature screw threads, precision gears, bearings, shafts, etc.

Dispersion No. 213, containing colloidal graphite, can be sprayed full-strength. Dispersion No. 223 contains colloidal molybdenum disulphide. Films properly formed with these dispersions show excellent adhesion and wear resistance. They are unaffected by oils and solvents, and can be used wherever temperatures do not go above 500°F.

In certain applications where electrical conductivity along with good heat stability is desired, Dispersion No. 213 also provides these properties. Acheson Colloids Co., Dept. ED, Port Huron, Mich.

CIRCLE ED-48 ON READER-SERVICE CARD

CIRCLE ED-49 ON READER-SERVICE CARD ➤

Audio Cables

Polyethylene Insulated

A new, complete line of cables for audio, intercommunication, microphone, TV camera and other audio applications are made with polyethylene insulation. This insulation features low loss, long life, good flexibility, and high dielectric strength. Non-marring "Chrome Vinyl" jackets, durability, minimum maintenance, and ease of stripping are outstanding qualities of the new cabling.

The thermoplastic materials used are moisture-resistant, abrasion-resistant, and impervious to oil, grease, and most chemical fumes. Conductors are color coded for circuit identification. All leads are tinned to simplify soldering operations. Components Div., Dept. ED, Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J.

CIRCLE ED-50 ON READER-SERVICE CARD

"O" Rings

Made to 0.020" ID

Available in sizes as small as 0.010" cross-section and 0.020" ID, subminiature "O" rings and other rubber parts are used in cables, micro switches and other electronic applications. They are made by an injection molding process. Minnesota Rubber and Gasket Co., Dept. ED, 3630 Wooddale Ave., Minneapolis 16, Minn.

CIRCLE ED-51 ON READER-SERVICE CARD

Laminates

Flame-Resistant

A new series of flame-resistant and flame-retardant laminates, impact phenolics, and fibrous materials can be blanked and punched as easily as standard grades of the same products. The flame-resistant ingredients of the laminates are a component part of the materials and not just a surface treatment. The entire series falls into Class A insulating materials. Rogers Corp., Dept. ED, Rogers, Conn.

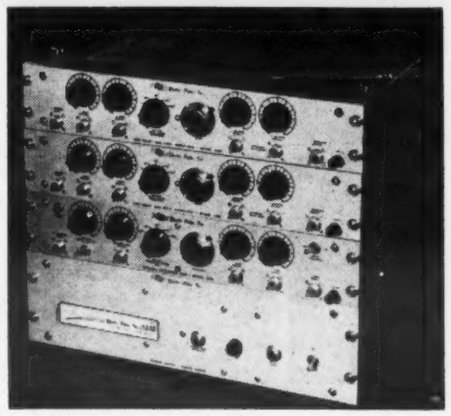
CIRCLE ED-52 ON READER-SERVICE CARD

◀ CIRCLE ED-49 ON READER-SERVICE CARD

New Products . . .

Pulse Generator

For Both Delay and Gate Uses



Utilizing block-unitized construction, the Model 2315A pulse generator consists of three semi-independent units and a power supply, providing either a variably delayed, variable-width pulse, or two variable-width pulses with no delay, or two variably delayed blocking oscillator pulses whose delays may be paralleled or cascaded from the sync pulse.

An internal oscillator source generates positive and negative variable amplitude sync pulses from 10cy to 100kc, direct reading in four decade related ranges, along with a sync pulse delayed 2μsec with respect to the initial sync pulses. External triggering and single shot operation are also provided.

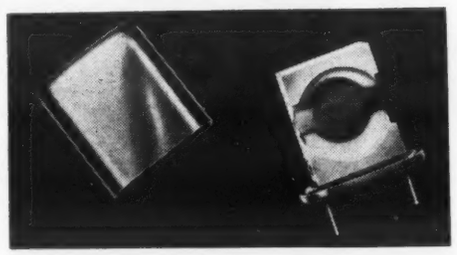
Delays are direct reading and variable from zero (with respect to the delayed sync pulses) to 10,000-μsec in five decade related ranges. Jitter is 0.02%, and the units are calibrated to an accuracy of 0.5% of full scale. Blocking oscillator delayed outputs of both polarities and of variable amplitude are available.

Gate pulse rise and fall times are 2μsec, and widths are direct reading and variable from 2μsec to 10,000μsec in the same ranges and with the same accuracy as the time delays. Positive and negative pulses are simultaneously available and are variable in amplitude to at least 50v across an internal 5000-ohms. Electro-Pulse, Inc., Dept. ED, 11811 Major St., Culver City, Calif.

CIRCLE ED-55 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal

Shock-Proof Unit

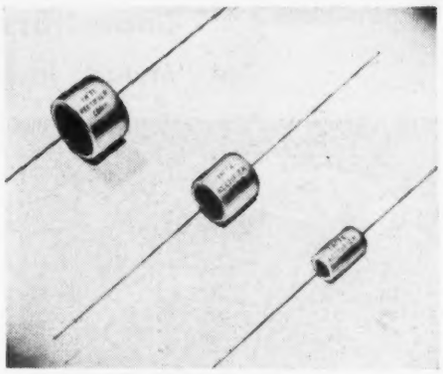


This 1Mc crystal unit in an HC-6 holder assures high stability in the low-frequency range. It utilizes a new nylon nest, permitting it to go down to 500kc. The crystal is firmly secured against shock without any hampering of its oscillating quality. It is built to meet all the requirements of the following MIL types: CR 18, 19, 27, 28, 35, 36, and 48/u. Reeves-Hoffman Corp., Dept. ED, Cherry & North Sts., Carlisle, Pa.

CIRCLE ED-56 ON READER-SERVCE CARD FOR MORE INFORMATION

Selenium Rectifiers

For Load Currents Under 50ma



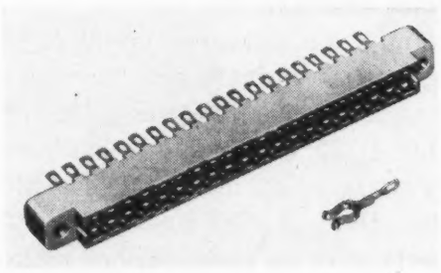
For electronic equipment requiring a load current of 50ma or less, the "CR" series of miniature rectifiers consists of a number of selenium cells assembled within a cylindrical aluminum housing. Size ranges from the smallest type (CR08), 0.375″ diam x 0.625″ long, to the largest (CR58), 0.750″ diam x 0.625″ long.

The rectifiers are rated for maximum rms input voltage of 130v and 160v for operation into a capacitive load, and have a d-c output current from 10ma to 50ma. For example, Type CR28 of this series is rated for a maximum of 130v input and will deliver approximately 170v d-c at 20ma with a capacitive filter. International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.

CIRCLE ED-61 ON READER-SERVICE CARD FOR MORE INFORMATION

Receptacle

For Etched or Printed Circuit Cards



This 20-contact receptacle for etched or printed circuit cards is interchangeable with present 18-contact receptacles both in mounting and in contact spacing. It makes it possible to expand etched or printed circuits without increasing the space required for the connector.

Made of beryllium copper wire, the contacts are formed, not stamped or machined, to assure constant pressure and dimensional uniformity. They are then heat-treated to give extra spring action. Each contact functions independently of the receptacle body. The contacts are stronger than the wires to be connected to them. They are gold-plated over silver for maximum conductivity, soldering ease, and corrosion-resistance.

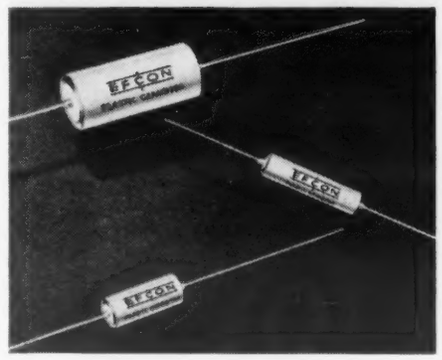
The connectors come complete with 20 contacts, including one dummy contact for positive polarization. They are supplied with either pierced tabs, as shown, or unpierced. The connectors are available with either a "Melamine" or an "Alkyd" 440A body, and a mounting hole with or without a threaded insert. Viking Electric, Dept. ED, 1061 Ingraham Street, Los Angeles 17, Calif.

CIRCLE ED-62 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Capacitors

Use "Mylar" Insulation



An economical process for constructing plastic film capacitors makes it possible to offer these units with close tolerances on a standard production basis. Designated Type MH, they are high quality, hermetically sealed tubular capacitors are available in any value from 0.01mfd to 1mfd with tolerances of 5%, 2%, and 1%.

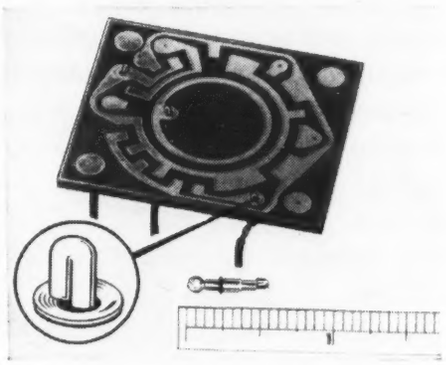
The capacitors utilize moisture-proof "Mylar" polyester film, providing high insulation resistance combined with very low dielectric absorption and extremely low power factor. They are hermetically sealed in metal tubular cases with glass-to-metal seal terminals at each end, in standard miniature case sizes. Non-inductive extended foil type construction with leads soldered directly to the foil insures minimum contact resistance.

Capacitors are offered in voltage ratings of 200v, 400v, and 600v d-c and are production tested to withstand a d-c voltage of 250% of rated voltage at 25°C, between terminals and between terminals and case. Absolutely no de-rating is necessary between −20° and +125°C. Change in capacitance is less than 5% between −30° and +90°C. Electronic Fabricators, Inc., Dept. A, 682 Broadway, New York 12, N. Y.

CIRCLE ED-65 ON READER-SERVICE CARD FOR MORE INFORMATION

Connector

Automatic-Locking Subminiature Type



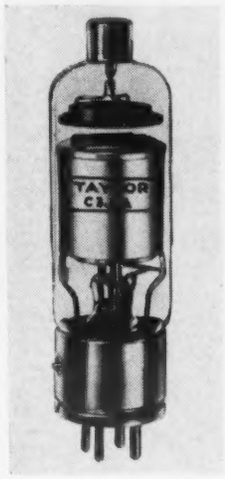
The Type "C" Subminiature Connector has all the features of the "Interlock" line: automatic locking, quick disconnect action, vibration-proof lock, and low contact resistance. Slightly over 1/2" long, it is especially suited for printed circuit use.

The connector is shown applied to a rotary switch plate circuit, illustrating how the wired plugs enter through set-in eyelets and lock automatically. Harvey Hubbell, Inc., Interlock Dept. (ED), Bridgeport, Conn.

CIRCLE ED-66 ON READER-SERVICE CARD FOR MORE INFORMATION

Thyratron Tube

Has Sharp Cut-Off



The *5684/C3J/A* is an improved version of the *C3J/A* Xenon Thyratron. It features grids constructed with the "Gold Flow" process, assuring sharp cut-off characteristics throughout tube life. Other features include an arc-resisting, high-emission cathode, nickel-brazed anode assembly, automatic gettering action, and metalized graphite anode. It is applicable to high-shock installations.

Average anode current is 3amp, and average arc drop is 8v. Ambient temperature limits are —55° to +85°C. Warm-up time is 30sec. The tube also features a substantial overload capacity and a low deionization time of less than 500μsec.

Life expectancy is over 2000 hours when operated within ratings. Size is 6 1/4" long x 1 9/16" diam. Taylor Tubes, Inc., Dept. ED, 2312 W. Wabansia Ave., Chicago 47, Ill.

CIRCLE ED-69 ON READER-SERVICE CARD FOR MORE INFORMATION

Screen-Room Filters

Current Capacity to 100amp

Based on extensive experience with screen-room requirements, six standardized models of filter units are now available in single, double, and triple-line types. All models have attentuation equal to or exceeding that of the screen room itself. Units are housed in sturdy steel casings with 1-1/4" diam countersunk mounting holes to permit flush mounting on the screen-room wall.

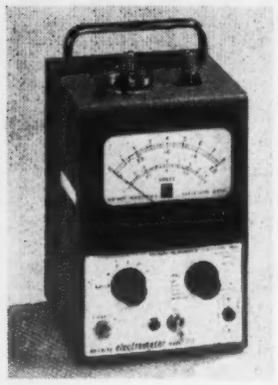
Removable covers at the ends facilitate wiring. Case sizes range from 2-3/8" x 2-3/8" x 10" for a 30amp, single-line model, up to 4-3/8" x 4-3/8" x 22" for a 100amp, single-line filter. Voltage ratings range from 250 to 500v at line frequencies from d-c to 1000cy. Attenuation characteristics range from 100db or more from 14kc to 1000Mc. Aerovox Corp., Dept. ED, New Bedford, Mass.

CIRCLE ED-70 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Vacuum Tube Electrometer

Has High Input Impedance



The Model 210 is a line-operated d-c vacuum tube voltmeter with an extremely high input impedance. Basic specifications includes an input greater than 10^{14} ohms, grid current below 10^{-13} amp, and drift within 10mv per hr. Five voltage ranges are provided: zero to 0.8v, 2v, 8v, 20v, and 80v, respectively, in either polarity.

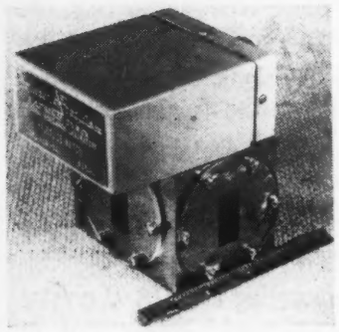
The electrometer has output terminals for driving balanced or unbalanced recorders and recorder amplifiers, oscilloscopes, and galvanometers. The output amplifier drives the Esterline-Angus 0-1 milliampere recorder directly, or delivers 10v out on each range for full-scale input. Frequency response of the output amplifier is 0-5000cy, making the Model 210 useful as a d-c preamplifier wherever an ultra-high input impedance is needed.

The unit can be used not only as a d-c voltmeter, but as an extremely sensitive micromicroammeter, megohmmeter, and kilovoltmeter. Maximum full-scale sensitivities are 8×10^{-13} amp, 3×10^{14} ohms, and 20,000v. Typical applications include potential measurements of charged capacitors, vacuum tube electrodes, and piezo-electric units. Keithley Instruments, Dept. ED, 3868 Carnegie Ave., Cleveland 15, Ohio.

CIRCLE ED-73 ON READER-SERVICE CARD

Waveguide Switch

Compact Unit

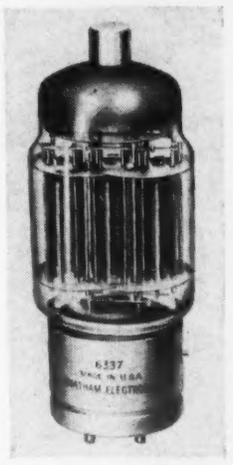


This waveguide switch, Model ASWI-XO1, makes available to the microwave field a compact unit, 3/4" x 1-1/2" guide size. It includes such features as: vswr, 1.05 to 1 maximum; crosstalk, 50db minimum; actuator, 110v 60cy; actuation time, 0.5sec maximum; vswr during switching, 1.2 to 1; power handling ability, approximately 0.35 megawatts cw. Thompson Products, Inc., Dept. ED, 2196 Clarkwood Road, Cleveland 3, Ohio.

CIRCLE ED-74 ON READER-SERVICE CARD

Power Triode

Rugged Tube for D-C Supplies



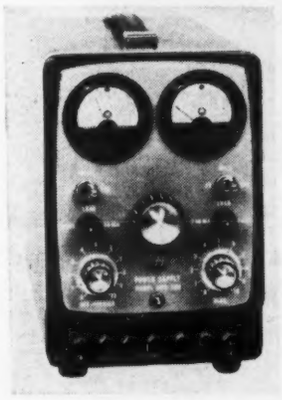
Tube Type *6337* features high plate dissipation and high perveance, plate current held within ±10%, and absence of plate current drift. Compact in design, this tube is capable of withstanding 500g shock. A hard glass envelope and a button stem that strengthens the mount, provide high immunity to extreme shock and vibration. Wide interlead spacing practically eliminates electrolysis.

Characteristics include: plate supply, 225v; bias resistor, 100 ohms; amp factor, 2.7; plate resistance, 60 ohms; plate dissipation, 80w; transconductance, 45,000μmhos; plate current, 450ma; heater power, 6.3v, 7.25amp, a-c or d-c. Chatham Electronics Corp., Dept. ED, 630 Mt. Pleasant Ave., Livingston, N. J.

CIRCLE ED-76 ON READER-SERVICE CARD

Power Supply

With 0.001% Regulation



The Model UHR-220 power supply features ultra-high regulation over its entire operating range under all conditions. It provides 0-200-ma at 0-500v, with 0.001% regulation and ripple less than 100μv. The d-c impedance is less than 0.01 ohms and the a-c impedance is less than 0.1 ohms in series with 0.1μh (4″ of wire). Transient response is 0.001millisec.

Output voltage is kept extremely stable even at low voltages by the use of drift cancelling differential amplifiers with regulated heaters, a new high stability reference tube, and low-temperature-coefficient wire-wound resistors. Full current can be drawn at any line voltage from 105v to 125v with a substantial safety factor. There is an additional negative supply of 0-5ma at 0-150v with less than 2mv of ripple. Center-tapped 12.6v a-c at 4amp is also supplied.

The two front panel meters are ruggedized and hermetically sealed with ranges of 0-50v and 0-500v and 0-200ma. Dimensions are 7″ x 10″ x 13″ deep. Krohn-Hite Instrument Co., Dept. ED, 580 Mass. Ave., Cambridge 39, Mass.

CIRCLE ED-77 ON READER-SERVICE CARD

New Products . . .

Power Supplies
For Use With Transistors

Because of the rapidly increasing use of transistors, this firm has developed closely regulated d-c tube-type power supplies for powering transistors. Models embody two basic types. Model T-100-B is a meter-equipped regulated dual-voltage power supply with two duplicate outputs. Each of these outputs has three ranges: positive or negative 0-1v, 0-10v, 0-100v; adjustment of the three ranges is made by decade switches and potentiometers. Maximum d-c current output is 100ma.

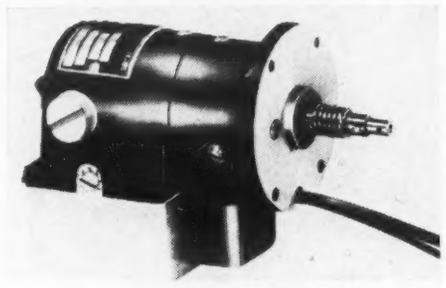
A similar unit, the Model T-100-D, has no meters. It provides the same output ranges as the Model T-100-B, but adjustment is by direct-reading decade switches in steps of 0.1v, with 0.1% accuracy.

Regulation of both units is 0.05% from no-load to full load. D-c internal impedance is 0.6 ohms, 0.1 ohm at 120cy, 0.4 ohm at 50kc. Input regulation is 0.1% change per ±10% variation in line voltage. Ripple is 1mv, maximum.

Size of the transistor power supplies is 5-1/4" x 19"; shipping weight is 40 lb. Units are for rack panel mounting and include dust cover and removable end plates. Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena 8, Calif.

CIRCLE ED-80 ON READER-SERVICE CARD FOR MORE INFORMATION

Shunt Wound Motor
Rated 0.02hp at 12,000rpm

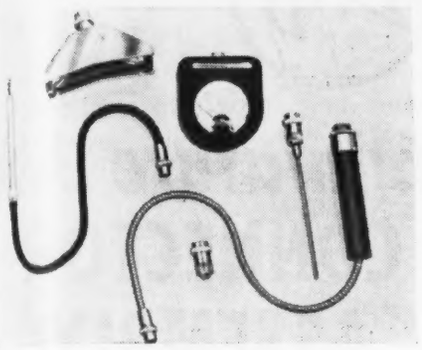


This shunt wound d-c motor, designed for military use, operates on 28v. It is rated 0.02hp at 12,000rpm and is furnished complete with noise filter and high altitude brushes. The motor employs precision ball bearings and stainless steel shafts for extra-heavy duty. All parts are finished in accordance with rigid military specifications. Electro Engineering Products Co., Dept. ED, 609 W. Lake Street, Chicago, Ill.

CIRCLE ED-81 ON READER-SERVICE CARD FOR MORE INFORMATION

Pocket Pyrometer

Handy Laboratory Device

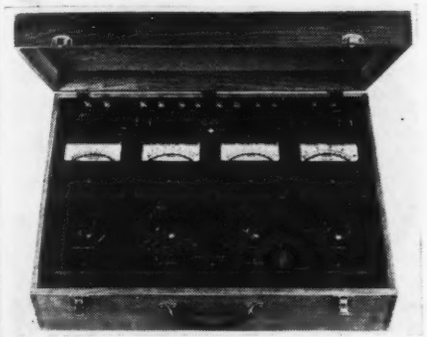


The "Cybertronic" Pocket Pyrometer (Model 240-T) offers quick, accurate measurement of surface and subsurface temperatures through the use of interchangeable thermocouples. Housed in a shock-absorbing rubber case which protects the instrument against normal shock, it is available in six standard ranges, starting at 400°F. It is 3-7/8" x 3-1/2" x 1-3/4" in size and has a 2.4" direct-reading indicator scale. Cybertronic Corp. of America, Dept. ED, Industrial Center, Third and Mortan Avenues, Chester, Pa.

CIRCLE ED-93 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C Test Set

For 60cy Measurements



The Universal "60" Alternating Current Test Set is a compact, rugged, and accurate set of instruments, designed to be used together and capable of giving the complete picture of 60cy voltages, currents, power, and power factor.

There are four separate instruments: two 18-range wattmeters, providing from 5w full scale to 2000w full scale, which can be used down to power factors of 10%; an ammeter with seven current ranges from 10ma full scale to 10amps full scale; and a voltmeter with four ranges from 30v full scale to 300v full scale. Sensitive Research Instrument Company, Dept. ED, 9-11 Elm Ave., Mount Vernon, N. Y.

CIRCLE ED-94 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Transmission

Has Two Magnetic Clutches

This differential transmission for servo systems contains two magnetic clutches and a suitable gear train which affords starting, stopping, and reversing of any load within the rating of the unit. This is accomplished on any desired duty cycle with continuous input-shaft rotation.

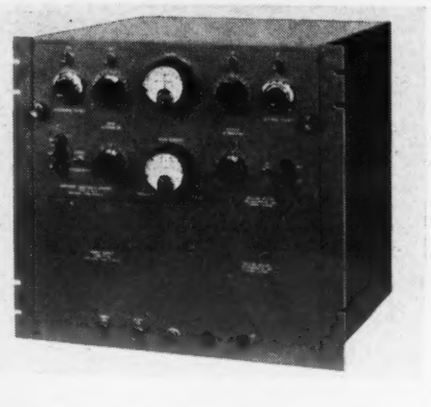
The transmission is available in any desired fractional horsepower rating and gear ratio. Electrical input by means of plug or barrier terminal strip is provided. B & W Electronic Research Laboratories, Dept. ED, 5629 Goodwin Ave., Dallas 6, Texas.

CIRCLE ED-95 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Special Amplifier

Generates Arbitrary Functions



The Type G-1A Arbitrary Function Generator is a special form of amplifier whose output signal can be related to input by any predetermined, arbitrary function of the form $y = f(x)$. Originally designed as a high-precision analog computer component, it is also well suited for handling non-linearities such as those encountered in missile telemetering and recording systems. Signal from zero frequency to several kilocycles can be handled.

Desired functions of the form $y = f(x)$ are plotted, and reproduced on standard lantern-slide templates. The slide is inserted in the instrument between its cathode ray tube and photoelectric tube follower, which is arranged to follow the slide's $y = f(x)$ outline. The voltage required to position the cathode-ray-tube beam in the y direction is amplified and used as the output signal. Instantaneous output signal is thus related to the instantaneous input signal in the same manner as y values on the template relate to x values.

The instrument has sufficient gain to permit operation with input signals as low as 0.1v for full scale. Output can provide up to ±100v or ±0.015amp full scale. The instrument operates from 117v, 50-60cy, and may be rack mounted or used on a table top. Wm. Miller Instruments, Inc., Dept. ED, 325 N. Halstead, Pasadena, Calif.

CIRCLE ED-89 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Motors

Can Operate at 160°C

These servo motors include BuOrd Mark VII and Mark VIII types, as well as 15 other variations. They are available with a wide choice of plain or pinion shafts.

High torque to inertia rational units, they can operate in the region of 160°C. They meet all military humidity, salt spray, and fungus test requirements. American Electronic Mfg. Co., Inc., Dept. ED, 9503 W. Jefferson Blvd., Culver City, Calif.

CIRCLE ED-90 ON READER-SERVICE CARD FOR MORE INFORMATION

Insulation

For High Voltages

"Panelyte" Grade 471 melamine canvas is intended for use in TV high-voltage insulation requirements. It features flame retardancy, which makes it valuable for such applications as terminal boards, filament holders, high-voltage shields, and fly-back transformers. It has superior water absorption, arc resistance and dielectric strength properties. Panelyte Division, Dept. ED, St. Regis Paper Co., 230 Park Ave., New York 17, N. Y.

CIRCLE ED-84 ON READER-SERVICE CARD

Picture Tubes

Two Aluminized Types

Two monochrome-TV picture tubes, models *17QP4* and *27SP4*, are 17" and 27" types, respectively. Both feature all-glass construction, rectangular, aluminized screens, gray-filter spherical faces, single-field ion traps, and external conductive coatings.

The 17" type is magnetically focused and deflected with a deflection angle of 70°. It has a screen area of 149 sq in. Its over-all length is 19-3/16". The 27" type is electrostatically focused and magnetically deflected with a deflection angle of 90°. Over-all length is only 23-1/16". Total picture area is about 425 sq in. Sylvania Electric Products, Inc., Dept. ED, 1740 Broadway, New York 19, N. Y.

CIRCLE ED-85 ON READER-SERVICE CARD

Coil Forms

Made to Specification

This firm supplies coil forms in any shape, size, length, ID, or OD within critical tolerances. Sizes from a fraction of an inch to 9" ID can be furnished without extra tooling charges. The forms can be wound from a wide range of dielectrical materials such as kraft, fish paper, acetate or combinations. Phenol impregnation is also available. Precision Paper Tube Co., Dept. EDN, 2035 W. Charleston St., Chicago, Ill.

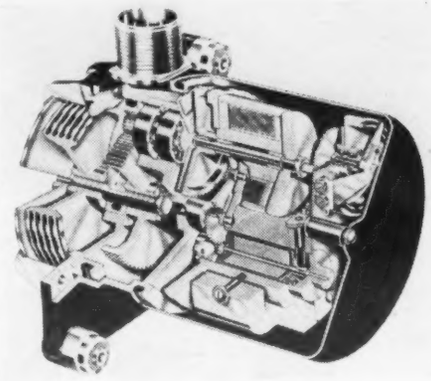
CIRCLE ED-86 ON READER-SERVICE CARD

CIRCLE ED-87 ON READER-SERVICE CARD ➤

New Products...

Position Servo Actuator

Features High Torque, Fast Response



A torque-to-inertia ratio of 200,000 rad/sec² coupled with an acceleration constant of 10 millisec are outstanding features of the Model 205 servo-actuator. It is offered in two basic versions: one for piloted, the other for pilotless aircraft. Each contains a drive motor, radio noise suppression network, low inertia precision gear train, and a follow-up potentiometer. In addition, the piloted model contains an overload and disconnect clutch, and the pilotless model an overload clutch. These elements are housed in a sealed, waterproof case 5-3/4" x 3-3/4" that weighs only 4-3/4 lb for the former and 4-1/2 lb for the latter. The output capstan of the unit is free to rotate 360°.

For a fixed supply voltage, output speed of the actuator is inversely proportional to applied load; for a constant load, speed of the actuator is proportional to the applied voltage. Control relays dynamically brake the motor when the control signal is removed. This quality allows the servo to maintain torque loads with only intermittent input power.

Maximum continuous torque at 28v is 200 in-lb. Additional torque outputs are available to customer requirements. Equivalent motor stall torque at 28v is 1200 in-lb. Operating voltage range is 5-35v. Operating current is 0.4amp at no load plus 0.1amp per in-lb of loads. Summers Gyroscope Co., Dept. ED, 2328 Broadway, Santa Monica, Calif.

CIRCLE ED-98 ON READER-SERVICE CARD FOR MORE INFORMATION

Phenolic Molding Material

Mica Filled

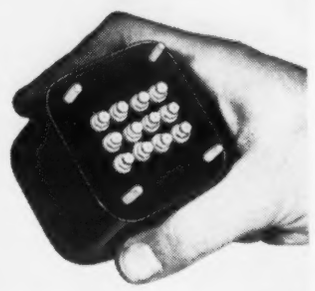
Resinox 3001, a mica-filled phenolic molding material, features improved moldability and mechanical strength. A thermosetting compound, it can be molded under the same conditions as other mica-filled phenolics.

The material is recommended for use in radio tube sockets, radio tube bases, electrical connectors, terminal strips, and miscellaneous electrical components where good electrical and mechanical strength are required. Monsanto Chemical Co., Dept. ED, Springfield, Mass.

CIRCLE ED-99 ON READER-SERVICE CARD FOR MORE INFORMATION

400cy Transformers

Withstand High Temperatures



These stock 400cy power and filament transformers and filter reactors are designed to meet MIL-T-27, Class B specifications for high-temperature operation. They are housed in seamless drawn steel, hermetically sealed cases with stud type terminals. Available in a full line, these units have ratings that were chosen after discussion with organizations engaged in the development of standards for aircraft, guided missiles, and related equipment.

All transformer primaries are rated 105/115/125v, 380-1,000cy. A wide variety of secondary voltages are available in the transformers. Chicago Standard Transformer Corp., Dept. ED, 3501 Addison St., Chicago 18, Ill.

CIRCLE ED-110 ON READER-SERVICE CARD FOR MORE INFORMATION

Conductive-Coatings Kit

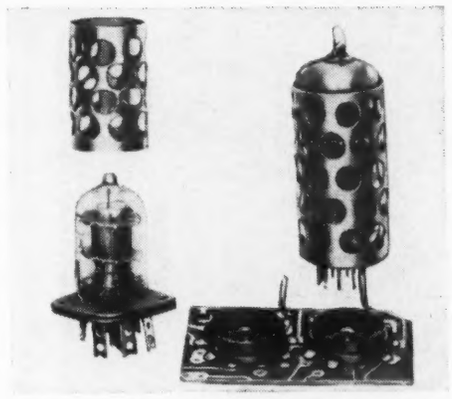
Makes 12 Coatings

Design and development engineers concerned with or contemplating use of conductive coatings for printed circuits and other applications will be aided by this Basic Laboratory Kit, Type S31. The kit contains six electrically conductive silver coatings, six resistance coatings, six accessory chemicals, manuals, and technical data. Quantities of each material range from one ounce to one pint. Micro-Circuits Co., Dept. ED, New Buffalo, Mich.

CIRCLE ED-111 ON READER-SERVICE CARD FOR MORE INFORMATION

Shields

Protect and Ventilate Tubes



"Ventilator" shields are designed to improve tube performance by dissipating heat. Their design makes for low cost of manufacture.

Easily handled, the shields are compression fitted to ground terminals on laminated or printed wiring sockets. They are available in lengths of 1-11/16" or 2-1/6", with one standard diameter which fits either seven- or nine-pin tubes. They can be furnished with tin or black oxide finish. Methode Manufacturing Corp., Dept. ED, 2021 Churchill St., Chicago 47, Ill.

CIRCLE ED-112 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products...

Nameplates
Non-Tarnishing

Made of 0.003" or 0.005" thick anodized aluminum, "Thinplate" nameplates will not tarnish or oxidize and are highly resistant to abrasion, humidity, and salt spray. They are backed by a pressure-sensitive adhesive that passes all military tests.

Available in anodized colors, these nameplates can be cut to any size or shape, and can be serial numbered in any typewriter. Park Nameplate Co., Dept. ED, 61-07 Thirty-Second Ave., Woodside 77, N. Y.

CIRCLE ED-106 ON READER-SERVICE CARD

Metal Bellows
Have Small Diameters

Hydraulically formed, seamless metal bellows of 1/4" and 5/16" diameters are available with a wide range of characteristics. These sizes serve as components of switches designed for aircraft.

The bellows are made of brass, phosphor bronze, beryllium copper and monel. Typical examples are 1/4" diam, two-ply, phosphor bronze bellows, and a 1/4" beryllium copper bellows that will withstand maximum external pressure of 2300psi. Bridgeport Thermostat Div., Robertshaw-Fulton Controls Co., Dept. ED, Bridgeport 1, Conn.

CIRCLE ED-107 ON READER-SERVICE CARD

Protective Coating
Applied by Spray

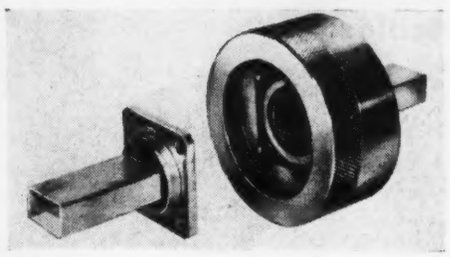
Effective protection against short circuits, corrosion and corona loss is provided by coatings sprayed on by "Sprayon" Plastic Sealer. The coating is high in dielectric strength and dries quickly to a non-tarnishing, flexible finish. It also acts to waterproof parts. The coating is applied by a handy 12-oz aerosol can with a non-clogging nozzle that requires only finger-tip pressure to operate. Champion Bronze Powder & Paint Co., Inc., Dept. ED, 2101 N. Elston Ave., Chicago 14, Ill.

CIRCLE ED-108 ON READER-SERVICE CARD

◀ CIRCLE ED-105 ON READER-SERVICE CARD

Waveguide Quick Disconnect

No Tools Required



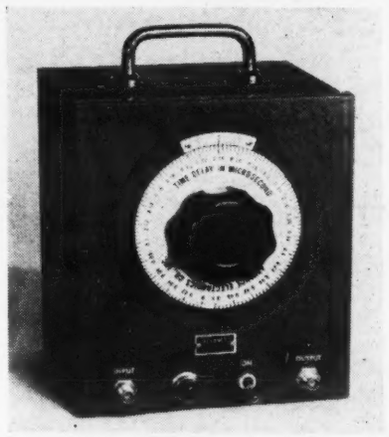
The Waveguide Quick Disconnect provides a reliable method of rapidly making and breaking waveguide connections. No tools of any kind are required. Connections are made by simply inserting the flange and hand tightening the outer ring. Proper alignment is automatic.

In addition to its uses as a piece of laboratory equipment, the disconnect is well suited for incorporation in microwave test sets as a front or rear panel fixture. It is available in sizes to fit the standard chokes and flanges of Types RG-51/U, RG-52/U, and RG-91/U waveguides. Aircraft Armaments, Inc., Dept. ED, P.O. Box 1777, Baltimore 3, Md.

CIRCLE ED-122 ON READER-SERVICE CARD FOR MORE INFORMATION

Time Delay Network

Continuously Variable



Type 303 continuously variable time delay passive network is very suitable for use as a time delay matching device in television systems, variable time delay for pulses, or precision measurement of small time intervals. Both the bandwidth and the transient response are excellent. The rise time is less than 7% of the time delay at any point, and the amount of overshoot is less than 2%. Resolution time is less than 5×10^{-10} sec, passing signals of any waveform. There is no time jitter.

This instrument consists of an input amplifier, an output amplifier, and a continuously variable delay line of which the time delay may be adjusted continuously by the front panel dial. Ten different types of continuously variable delay lines are available, with the shortest one being 0 to 0.05μsec and the longest being 0 to 0.8μsec.

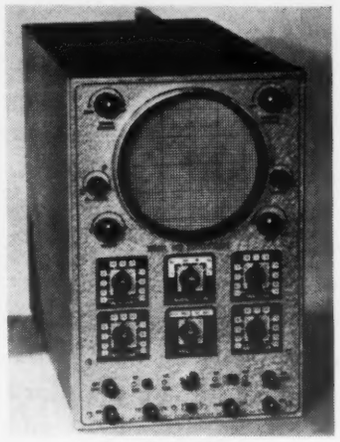
The input impedance is 1 megohm shunted with 20mmfd. The output impedance is 1 megohm shunted with 15mmfd. Both the input and the output impedance can be made lower by shunting the terminals with proper resistors. Both amplifier stages have 15Mc bandwidth and 10v peak-to-peak maximum signal level. Accuracy can be maintained within $\pm 1\%$ after calibration. Advance Electronics Co., Inc., Dept. ED, 451 Highland Ave., Passaic, N. J.

CIRCLE ED-309 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Oscilloscope

Precision Low Cost Unit



By combining engineering advances with large scale production, this firm is able to offer the same precision features in the Model 600 as in oscilloscopes selling up to twice its price. Some of the features of the new design are: a 5UP1-5" scope tube for sharp focusing and good intensity; a retrace blanking amplifier that eliminates confusion and gives clear, sharp pictures; a two-step compensated attenuator input; and a two-stage push-pull vertical amplifier with sensitivity 0.02v per inch.

Synchronization is also available on either positive or negative phase of input voltage through the vertical amplifier or from an external source. Electronic Measurements Corp., Dept. ED, 280 Lafayette St., New York, N. Y.

CIRCLE ED-116 ON READER-SERVICE CARD FOR MORE INFORMATION

Compressor Amplifier

Provides Constant Output

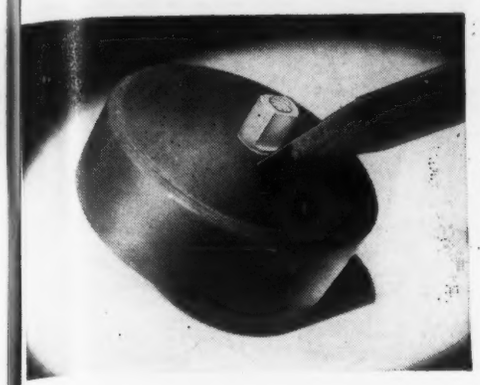
The Type 501-A Compressor Amplifier is ideal for stabilizing varying signals to eliminate the necessity of adjusting levels when measurement or observation of signals are to be made with oscilloscopes, bridges, phase comparators, or wave analyzers. The instrument accepts input signals of variable amplitude between 1.25 and 50v and delivers an output signal of the same waveform but held at a substantially constant amplitude of 0.25v ($\pm$4db) by a servo-controlled distortionless variable attentuator.

Compression ratio is 40 to 1 (32db) from 500cy to 1Mc, slightly less below 500cy. Frequency range for complex signals at any compression condition is 50cy to 50kc, within $\pm$3%. Input impedance is 10 megohms shunted with less than 10mmfd, and output impedance is less than 100 ohms for frequencies above 500cy. Technology Instrument Corp., Dept. ED, Acton, Mass.

CIRCLE ED-117 ON READER-SERVICE CARD FOR MORE INFORMATION

Slug Capacitors

Designed for Color TV Needs



Developed primarily for the critical requirements of color TV, these "Cartwheel" slug ceramic capacitors are available in ratings up to 30kv and are capable of operating under extreme humidity and at elevated temperatures. They are encased in casting compound as distinguished from the usual thermosetting molded plastic.

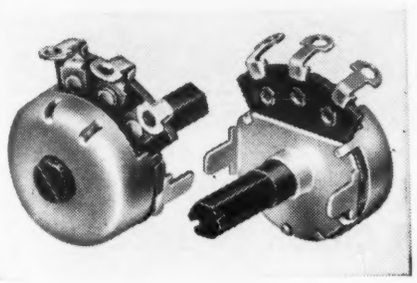
The sealing technique results in much higher corona-starting voltages, greatly increased dielectric strength, excellent arc-resistance properties, and an insulation resistance greater than 50,000 megohms. They have a power factor of 1.5% maximum at 1000cy and a long service life.

Cartwheels are available in a choice of sizes, voltages, and capacitance as well as several terminal styles. Hi-Q Division, Dept. ED, Aerovox Corporation, Olean, N. Y.

CIRCLE ED-102 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Resistor

Shaft Adjustable at Both Ends



Designated Type LR6, a low-cost, tab-mounting variable resistor features a Bakelite shaft that is adjustable at both ends. The units are designed for use as rear-of-chassis and concealed front panel controls in TV receivers, as pre-set gain controls in multiple-input pre-amplifiers, and in other circuits requiring only occasional adjustment. The insulated shaft feature is particularly desirable where the chassis or mounting plate is operated above ground.

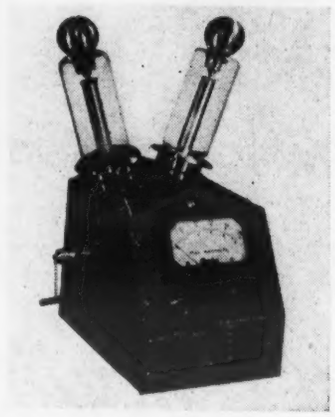
The slotted hexangular shaft extending forwards is adjustable by hand, 7/32 hex nut driver, or screwdriver. The rear portion of the Bakelite shaft is round with a screwdriver slot and projects slightly beyond the cover of the control. The units are available with shaft lengths of 3/16", 1/2", 5/8", 3/4" and 1" in all resistance values, tapers and other specifications according to RETMA Standards. Electronic Components Div., Dept. ED, Stackpole Carbon Co., St. Marys, Pa.

CIRCLE ED-103 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Peak Reading Voltmeter

Measures up to 100kv



The High Voltage Vacuum Tube Voltmeter is a peak reading device designed to measure audio, supersonic, and r-f voltages that exceed the voltage range of most oscilloscopes or vacuum tube voltmeters. Utilizing two vacuum capacitor voltage dividers, it has five voltage ranges, including a 50kv range for single-ended use and a 100kv range for double-ended use.

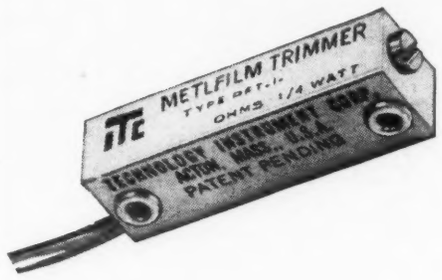
Frequently response is flat from 50cy up to 20Mc (or up to 50Mc if derated to half voltage). Loading capacity is less than 4mmfd, making the unit extremely useful in measuring and viewing high voltage pulses. It has a time delay of 0.16sec.

Transient viewing is facilitated by the oscilloscope connection provided for each divider with a division ratio of 300:1 and a resonant point of 220Mc. Oscilloscope calibration is simplified by a provision for easy switching from the scope to the meter. Jennings Radio Manufacturing Corp., Dept. ED, P. O. Box 1278, 970 McLaughlin Ave., San Jose 8, Calif.

CIRCLE ED-127 ON READER-SERVICE CARD FOR MORE INFORMATION

Trimmer Potentiometers

Have Infinite Resolution

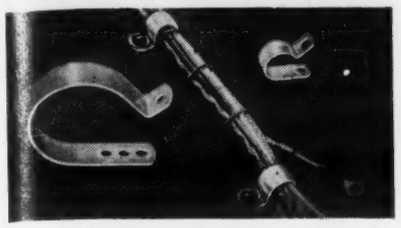


Featuring infinite resolution, the Type RFT "Metlfilm" miniature trimmer potentiometers are made in a wide range of total resistance values. They embody a deposited metal resistance element that is tough and smooth and has excellent characteristics of noise and wear.

The sliding contact rides upon the adjusting screw and contacts all of the available resistance variation with approximately 25 turns of this screw. A 90° turn of the drive screw results in an approximate voltage change of 1% of the applied voltage. Voltage settings can be maintained with great precision. With a mounting surface about 3/8" square, these potentiometers can be stacked so that seven units occupy a square inch of panel space. Technology Instrument Corp., Dept. ED, Acton, Mass.

CIRCLE ED-128 ON READER-SERVICE CARD FOR MORE INFORMATION

NYLON CABLE HANGER . . . high-strength clip resists temperature extremes, chemicals



Eleven standard diameter sizes accommodate single cables or bundles from 3/16" to 2". Several sizes have two or three-hole tongues, to permit diameter adjustment in installation.

Combining the best features of metal clips with the advantages of nylon, Burndy molded nylon cable hangers weigh 70% less than metal cable clips of comparable size, yet have sustained loads of more than 300 lbs., in the larger sizes. Extremely flexible, these nylon cable hangers are preformed, for ease of installation, requiring no shaping or forming on the job and retaining their shape permanently. Resistant to sustained temperatures from −60°F to 250°F, these cable hangers are also unaffected by oils, gasoline, alcohol, or hydraulic fluid. An insulator itself, this type of cable hanger cannot cause grounds or short circuits and is free from hysteresis losses. Smooth, rounded-edge, non-abrasive surfaces facilitate installation and prevent injury to insulation.

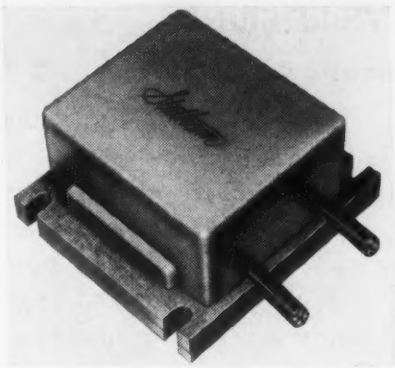
For information on Burndy nylon cable hangers, write **Department ED, BURNDY, Norwalk, Connect.**

83-7

CIRCLE ED-131 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE ED-132 ON READER-SERVICE CARD FOR MORE INFORMATION

Linear Accelerometers
Withstand Wide Temperature Range



This series of linear accelerometers in ranges from ±0.5g to ±15g is designed to satisfy the need for acceleration transducers that perform reliably under variable temperature conditions, such as are encountered in flight operations. Operation through the ambient temperature range of —65° to ±120° is afforded by means of an electrical heater jacket with a peak power input of approximately 20w to 30w.

Illustrated is the Model A17 accelerometer, which is offered in ranges from ±1g to ±15g. The transducing element is the Statham unbonded resistance strain gage. Statham Laboratories, Inc., Dept. ED, 12401 W. Olympic Blvd., Los Angeles 64, Calif.

CIRCLE ED-133 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Power Supply
Precision Laboratory Unit

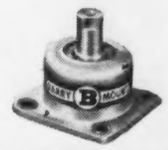
This "super-precision" d-c power supply is designed for laboratory applications requiring very closely-regulated power. Designated the Model D3-300-E Multiple Power Supply, it is actually four power supplies in one.

One supply output is rated from 0 to 300v d-c, at 300ma. Regulation from no-load to full load is 0.003v load variation (0.001%). Ripple is 0.01millisec. A second output is identical, except for a current of 150ma.

Another rating of the supply provides continuously variable voltage from 0 to —150v, negative in respect to Output No. 2, with maximum current of 5ma regulated to line voltage but delivered through a 25,000 ohm, 10-turn "helipot". A fourth output provides continuously adjustable, unregulated filament voltage, 0 to 10v a-c at 10 amps maximum. Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena 8, Calif.

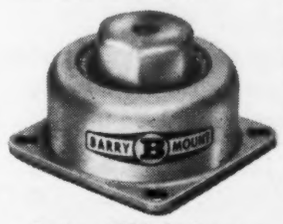
CIRCLE ED-134 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW ALL-METL VIBRATION ISOLATORS
Operate at Extreme Temperatures



Series M24 Isolator

Series M44 Isolator



Series M64 Isolator

New, miniature, ALL-METL BARRYMOUNTS — Series M24 — have been added to the Barry line. The stainless-steel spring and wire-mesh construction of this tiny, new mount enable it to provide excellent isolation at extreme high or low temperatures. The M24 series meets all pertinent requirements of MIL specifications, as also do the larger M44 and M64 ALL-METL BARRYMOUNTS.

The weights and load ranges of ALL-METL BARRYMOUNTS are: miniature Series M24 — ½ oz., 9 load ratings covering range of 0.1 to 3 lbs.; JAN-size 1, Series M44 — 1½ oz., 6 load ratings covering range of ½ to 10 lbs.; JAN-size 2, Series M64 — 4¼ oz., 8 load ratings covering range of 2 to 40 lbs. Write for Product Bulletins 542(M24), 534(M44), or 536(M64).

Special and standard mounting bases using any of these three ALL-METL BARRYMOUNTS can be furnished; detailed reccommendations on request.

BARRY CORP. 775 Pleasant St., Watertown 72, Mass.

CIRCLE ED-135 ON READER-SERVICE CARD FOR MORE INFORMATION

RESISTORS MUST BE GOOD before they can bear the "Milwaukee" name! That's what we said when we set about developing these ECONOMY resistors. Our engineers checked many materials and worked with factory production to assure *top ranking performance.* THE RESULT — resistors embodying more costly raw materials, but greatly reduced in cost by the new manufacturing techniques these materials afford. They are available in the same sizes and ohmages as our vitreous enameled resistors. Write, wire or phone for quotations — samples!

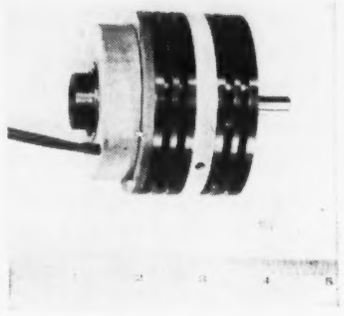
MILWAUKEE RESISTOR COMPANY
702 W. VIRGINIA ST., MILWAUKEE 4, WIS.

CIRCLE ED-136 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Magnetic Fluid Clutch

High Torque, Smooth Action Device



The 731B Magnetic Fluid Clutch is for use as a clutch element in reversing or speed changing transmissions, as a precision take-up device, and for many other applications. It utilizes a grease-like lubricant in which extremely fine magnetic particles are suspended. The application of a-c to the coil may be made from the plate of conventional vacuum tubes or suitable rectifiers. This causes the fluid to "stiffen" in proportion to the current. The fluid thereby acts as a clutch "lining", and the varied current produces torque much like the varied clutch pressure of a conventional clutch.

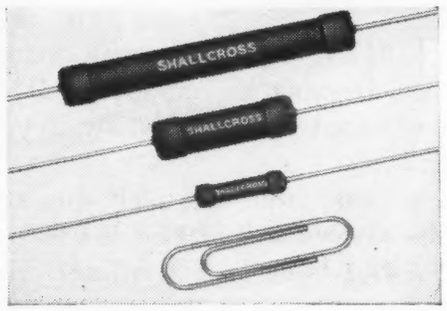
The clutch allows for 40w of heat dissipation and develops up to 50 in-lb of torque. At the maximum recommended speed of 800rpm, it can transmit up to 475w (2/3hp). The standard coil resistance is 1700 ohms, and a coil current of 75ma gives full torque, thus delivering a power gain of 50 at 800rpm.

Ball bearings and fluid seals result in a high precision device with high torque, smooth action. Weight is only 3-1/2 lbs. Size is 3-1/4" diam x 3-49/64" overall length. Raymond Engineering Laboratory, Inc., Dept. ED, Middletown, Conn.

CIRCLE ED-139 ON READER-SERVICE CARD FOR MORE INFORMATION

Boro-Carbon Resistors

Meet Specification MIL-R-10509A

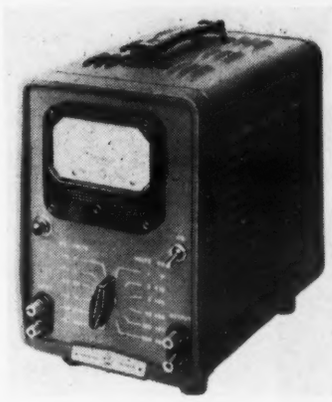


Known as the "Borohm" series, a line of 1/2, 1, and 2w boro-carbon resistors exceed all requirements of MIL - R - 10509A, Characteristic "R" as proved by temperature cycling, moisture resistance, and load life tests. The units have a tough epoxy resin coating that withstands rough handling.

Three styles are available. Type BC20 is rated 1/2w, Type BC25 is rated 1w, and Type BC30 is rated 2w. Standard resistance tolerances are 1, 2 and 5% with stability averaging 0.2% after 1000hr load life tests. Shallcross Manufacturing Co., Dept. ED, Collingdale, Pa.

CIRCLE ED-140 ON READER-SERVICE CARD FOR MORE INFORMATION

Vacuum Tube Voltmeter
Has Wide Frequency Range



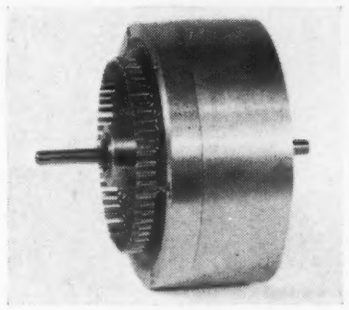
The Model 400D high accuracy vacuum tube voltmeter covers all frequencies from 10cy to 4Mc. It measures voltages from 0.1mv to 300v, and is accurate to within 2% up to 1 megohm. Input impedance is 10 megohms so circuits under test are not loaded. The instrument has a new amplifier circuit providing approximately 56db of feedback in mid-range for high stability and freedom from calibration changes caused by external conditions.

Ranges are selected on a front panel switch that changes sensitivity in accurate 10db steps. This switch plus calibration of the 4" meter directly in decibels means direct readings are available without calculation or conversion between —72dbm and +52dbm. Readings are always in the upper part of the scale where maximum accuracy is obtained.

In addition to measuring gain, response and output level, the voltmeter measures hum and noise directly, determines power circuit and broadcast high frequency voltages, serves as an audio level meter and high gain broad band amplifier, detects nulls, monitors waveforms, and measures coil "Q", capacity, and resonance. Hewlett-Packard Co., Dept. P, 395 Page Mill Rd., Palo Alto, Calif.

CIRCLE ED-145 ON READER-SERVICE CARD FOR MORE INFORMATION

Sampling Switch
Only 2" diam x 1" long

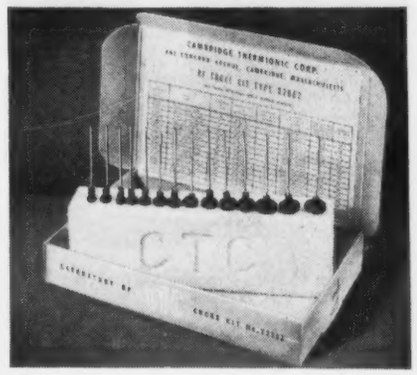


Contact plates molded with high quality mica-filled resin are employed in this high-speed precision switch. The design shown measures only 2" diam x 1" long. It is made in the same way as larger and subminiature commutators of standard form used for telemetering, thermocouple correction of multiple amplifiers, and for other uses.

Switches are available with any of a large variety of contact materials selected according to the amplification, and with a variety of features, such as number of contacts, number of poles, and sampling rates. They can be supplied with single or double-ended shaft, or integrally mounted with driving motor. General Devices, Inc., Dept. ED, P.O. Box 253, Princeton, N.J.

CIRCLE ED-146 ON READER-SERVICE CARD FOR MORE INFORMATION

New RF Choke Kit
Contains 14 pie-wound chokes



Chokes are on LPB-3 forms, which have axial leads and are only 5/32" in diameter by 1/2" long. Windings are 1/8" wide, varying up to 1/2" approximately in diameter. All units varnish-impregnated for moisture and fungus-proofing. Inductances are RMA preferred values from 6.8 microhenries to 1.0 millihenry, with color-coding enabling easy recognition of values.

Modern packaging adds to the advantages of the kit for laboratory or experimental use. Supported in a foam plastic block, the chokes are protected from damage in transit and can easily be removed and reinserted. Block stands on any flat surface. Chart on inside cover of kit gives necessary electrical data, plus C.T.C. part numbers for ordering separately or in bulk. Kit price is $4.25 F.O.B., Cambridge, net 30. Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Mass.

CIRCLE ED-150 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products...

Single-Sideband Filter

Utilizes Toroid Coil

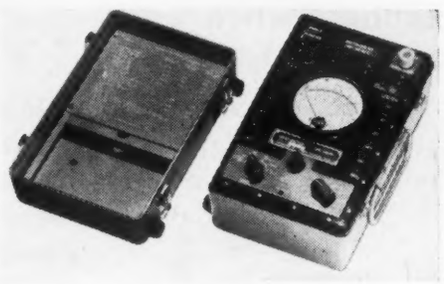
The Type S-15000, a low-cost, single-sideband filter, utilizes a toroid coil instead of costly crystal filters. It is similar to this firm's SSB filters and is designed to be a mass-produced SSB filter for incorporation into new designs by set manufacturers.

The filter features compact size and ease of installation. Fixed tuned and hermetically sealed, it requires no adjustment, is rugged and trouble-free. It may be installed in any existing amateur receiver now in use. It makes possible long-range reception with reduced interference and distortion not only of SSB signals, but of any a-m transmission. It utilizes 50kc as a 2nd i-f, and provides a narrow-band, sharp cut-off response which insures maximum intelligibility and maximum signal intensity. Burnell & Company, Dept. A, 45 Warburton Ave., Yonkers, N. Y.

CIRCLE ED-151 ON READER-SERVICE CARD FOR MORE INFORMATION

Volt-Ohm Microammeter

Waterproof Construction



The PL 1004 "Multimeter" is identical to this firm's TS352B/U waterproof volt-ohm microammeter built to Specification MIL-M-4269 (USAF) and supplied to the armed forces. Now available for commercial and industrial use, it is a self-contained instrument used for testing elements of electronic and electrical circuits to determine specific electrical characteristics, and to check current, resistance, and voltage in existing circuits. It is adaptable for both a-c and d-c measurements.

Environment-free features include: a rugged, sealed 4-1/2" meter; waterproof jacks; and a design that permits immersion in its gasket-sealed cover without affecting accuracy. Test leads and accessories are provided with the instrument. Phaostron Co., Dept. ED, 151 Pasadena Ave., South Pasadena, Calif.

CIRCLE ED-152 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW DATA AVAILABLE ON PRECISION SERVO MOTORS

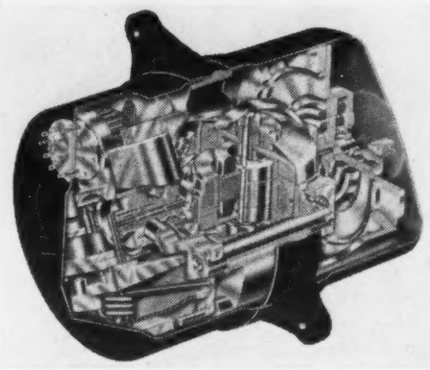
An informative new catalog about Servo Motors is now available from G-M Laboratories Inc. Known as Servo Motor Catalog Number 4, it gives dimensions and characteristics on standard types of G-M precision Servo Motors which can be sampled or produced in quantity within the shortest time possible. By using this catalog as a guide, it is easy to pick out a standard unit to meet dimension and performance specifications. Engineering drawings and characteristics charts are in easy-to-read form. A description of the quality and variety of materials that go into these precision motors is included; also a simplified outline to be followed when ordering standard motors.

G-M LABORATORIES INC.
4284 N. Knox Ave., Chicago 41, Ill.

CIRCLE ED-153 ON READER-SERVICE CARD FOR MORE INFORMATION

Reference Gyro

Reaches Control Speed in 10sec



The Model 221 airborne reference gyro accelerates to operational control speeds in only 10sec. It is designed to withstand extreme acceleration and shock up to 60g. It will successfully operate, without excessive drift, during vibration up to and including 10g at 1500cy.

The unit is a two-degree-of-freedom gyro that measures displacement about two axes by means of a pickoff placed on each gimbal axis. Use of an electrically operated caging device permits the caging cycle to be completed in 4sec for normal displaced positions. With the gimbal displaced 180°, maximum caging time is 20sec. The gyro can be completely uncaged in less than 0.1sec.

The unit is offered with either a 28v d-c, a 115v d-c, 400cy single phase, or a 115v d-c, 400cy three-phase power supply. Pickoffs are supplied as either potentiometer type or a special "pancake" type precision synchro. Maximum drift will not exceed 0.1° per minute in either a-c or d-c units. The unit with a-c pickoff is contained in 3-1/2″ diam x 5-1/8″ long case. Length with d-c pickoff is 5″. Weight is 4-3/4 lb. Summers Gyroscope Company, Dept. ED, 2328 Broadway, Santa Monica, Calif.

CIRCLE ED-157 ON READER-SERVICE CARD FOR MORE INFORMATION

Square Wave Generator

For Testing Wide Band Amplifiers

A new generator, Model 183, provides square waves suitable for testing the transient and frequency response of wide band amplifiers, and accurately measures their amplitude. The frequency range is from 10cps to 1Mc, continuously variable over decade steps.

This unit has a low impedance output which provides 10v, peak-to-peak. At high impedance, 100v, peak-to-peak, is available. A 60db step attenuator and a 20db continuous attenuator (which do not affect wave shape) provide means of using the generator as a voltage calibrator. New London Instrument Co., Dept. ED, P. O. Box 189, New London, Conn.

CIRCLE ED-158 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Transformers

Miniature Plug-In Designs

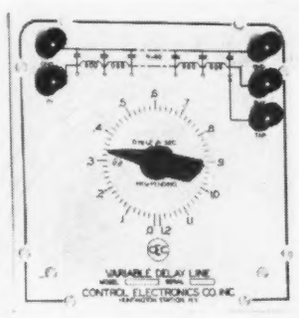
These audio transformers are built into a molded octal base, 1-15/32" high x 1-1/32" diam. To assure maximum leakage resistance, they are embedded in a high melting point resin. They have the same nominal ratings as this firm's previously cataloged items. On special order, they are available with buss-type leads to enable use in printed circuits; the lead size varies from #22 for the "Miniature" size transformer, to #26 for the "Veri-Miniature" type.

Units of this type are being used in guided missile and encapsulated construction, as well as for radio paging and hearing aid applications. Microtran Co., Dept. ED, 84-11 Rockaway Beach Blvd., Rockaway Beach 93, N. Y.

CIRCLE ED-165 ON READER-SERVICE CARD FOR MORE INFORMATION

Delay Line

Provides 0-1.2μsec Delay



The Model V-104 Delay Line provides a variable delay of from 0-1.2μsec. The delay is obtained with a lumped-constant circuit consisting of 60 coil and capacitor sections. The delay of each section is 0.02-μsec. A 60-contact rotary switch is used to tap the delay line at the desired delay. Since the switch is of the shorting type, an incremental delay of 0.01μsec is obtained with the switch in the shorted position, thus providing 120 steps.

Overall accuracy is 5%. The rise time varies with delay from less than 0.02μsec to approximately 0.04μsec. Nominal impedance is 2700 ohms.

The unit is useful as a laboratory instrument for all types of pulse work, including computers, radar, television, etc., and can also be used accurately to provide and measure phase shifts. It may be connected in series with other units of the same impedance manufactured by this company. Other models, both fixed and variable delay types, are available. Control Electronics Co., Inc., Dept. ED, 1925 New York Ave., Huntington Station, N. Y.

CIRCLE ED-166 ON READER-SERVICE CARD FOR MORE INFORMATION

Gain Measuring Set

For Microwave Measurements

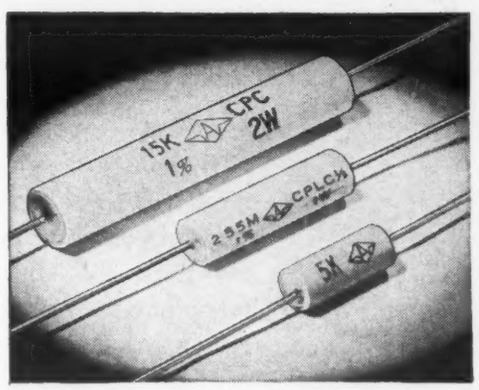
The new "Radalyzer" gain measuring set has a 30Mc i-f for low low-level microwave measurements. It has the following features: gain-loss measuring range is 0 to more than 60db vswr; 0 to more than 60db insertion loss or gain; receiver frequency of 30Mc; and operating (signal) frequency range from 40Mc to 10Mc (furnished by external equipment under test).

Input rating is 50mv maximum at 30Mc into a 50 ohm line. Attenuators are 0-101 db (steps—1, 2, 3, 5, 10, 20, 20, 20, 20). The unit has a 0-10db precision 10-turn potentiometer, calibrated. Regulated voltages are furnished for two external klystrons by the power supply. Pre-amp gain is linear over input level changes of more than 60db. Kay Electric Company, Dept. ED, 14 Maple Ave., Pine Brook, N. J.

CIRCLE ED-169 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Resistors

Have Hermetically Sealed Ceramic Case



Designated as Type CPC, a ceramic-case version of the "Carbofilm" precision resistor is housed in a ceramic tube with metallized ceramic end-seals for complete and permanent hermetic sealing. There is no capacitance effect between element and casing. The leakage path is very long.

The resistors, made to guaranteed tolerance of ±1%, have excellent stability with respect to temperature changes, voltage, noise, etc. They withstand extreme humidity and heat. Available in 1/2w, 1w, and 2w sizes. Hi-Q Division, Dept. ED, Aerovox Corporation, Olean, N. Y.

CIRCLE ED-170 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products...

Voltmeter

For 5-150kc Carrier Measurements

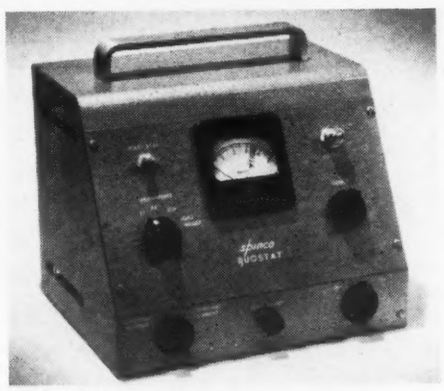
A compact precision-built voltmeter, the Model 104 is designed for measurements on communication systems. It covers a frequency range from 5kc to 150kc and has a frequency calibration accuracy of + 1kc. The signal measurement range is —80 +42dbm at 600 ohms impedance, and signal measuring accuracy is ±2db over the range —70 +42dbm.

Input impedance is 10,000 ohms in the pass band, and is appreciably higher in the rejection band. The instrument has unusually high selectivity; response is down 3db at 300cy of resonance, 45db at 1,500cy of resonance. It reads direct in dbm, and is designed for operation into an unbalanced 600 ohm line. It may be converted quickly to balanced operation for 135 ohm or 600 ohm balanced line measurements with the Model 155 Line-Bridging Transformer. This transformer may be readily plugged into the input terminals on the front panel. Sierra Electronic Corporation, Dept. P, 1050 Brittan Ave., San Carlos 2, Calif.

CIRCLE ED-175 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

Provides Constant Current or Voltage



The "Spinco Duostat" provides facilities for both constant - current and constant-voltage operation. Energized from a standard 115v 50/60cy power outlet, it can provide currents from 5ma to 50ma, automatically regulated to ±2% at voltages from 100v to 500v. In its constant voltage mode of operation, it is self-regulated to ±1% from 160v to 500v, over a load current range of 0 to 50ma.

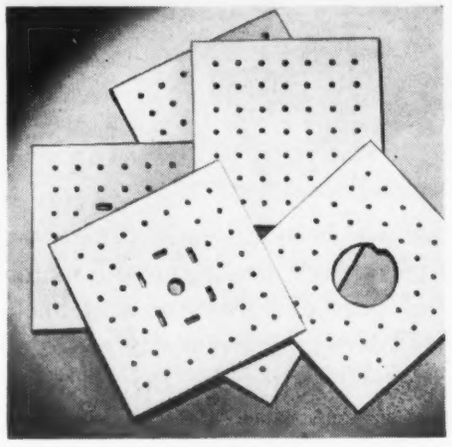
Output is relatively unaffected by line voltage changes between 105v and 150v. Housed in a portable metal cabinet measuring 9-1/2" x 10-1/" x 9-1/2", it has a top-mounted carrying handle and weighs 11-1/2 lbs. Specialized Instruments Corp., Dept. ED, 532 O'Neill Ave., Belmont, Calif.

CIRCLE ED-176 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Printed-Wiring Boards

With Pre-Punched Holes



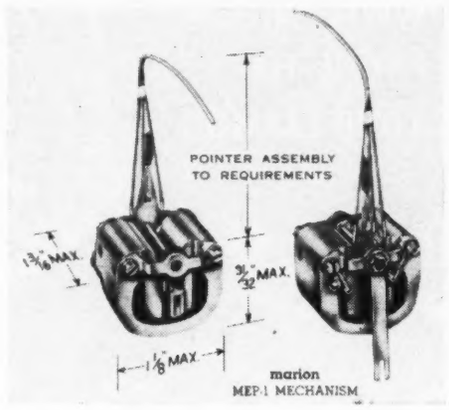
To avoid the need for special tooling for punching the necessary holes in a printed-wiring board, designers can utilize pre-punched standard boards known as "Quad-Kards". Furnished in standard 2″ square segments with or without conductors printed to specification, Quad-Kards have standard hole punchings for tube sockets, transformers, and capacitors, plus a grid pattern of 0.050″ diam holes on 1/4″ centers for conductors.

These boards may be abutted, angled, or stacked during incorporation into finished assemblies. Methode Manufacturing Corp., Dept. ED, 2021 W. Churchill St., Chicago 47, Ill.

CIRCLE ED-186 ON READER-SERVICE CARD FOR MORE INFORMATION

Meter Mechanism

With Gyro-Like Stability



The mechanical design of this meter mechanism provides performance stability typical of that of a gyro. It is especially applicable in aircraft instruments and similar applications where the effects of vibration and rapid attitude changes must be considered.

Designed to develop maximum torque for a given volume of magnetic material, the mechanism employs an end-pivoted coil assembly with a one-piece bearing shaft and precise mechanical assembly that operates in a self-shielded magnet structure. This construction produces approximately 6000 gauss in a single air gap. Operation of the moving coil, of long turning radius, in a magnetic field of such strength, achieves gains in torque and eddy current damping.

Performance characteristics of the new mechanism also suggest application as the sensitive element in control devices where it is required to initiate a control function. Marion Electrical Instrument Co., Dept. ED, 400 Canal St., Manchester, N. H.

CIRCLE ED-187 ON READER-SERVICE CARD FOR MORE INFORMATION

TV-Receiver Tubes

For "Series-String" Circuits

Twenty-six vacuum tube types designed for "series-string" operation in TV receivers feature a common heater current of 600ma at a variety of heater voltages ranging from 2.35v to 25v. The tubes, with their prototype with the same electrical characteristics given in parentheses, are as follows: *2AF4* (*6AF4*), *3AL5* (*6AL5*), *3AU6* (*6AU6*), *3BC5* (*6BC5*), *3BE6* (*6BE6*), *3CB6* (*6CB6*), *4BQ7A* (*6BQ7A*), *4BZ7* (*6BZ7*), *5AN8* (*6AN8*), *5AS8* (*6AS8*), *5T8* (*6T8*), *5U8* (*6U8*), *6AU7* (*12AU7*), *6AX7* (*12AX7*), *6S4A* (*6S4*), *6SN7GTB* (*6SN7GTA*), *12AX4GTA* (*12AX4GT*), *12B4A* (*12B4*), *12BQ6GT* (*6BQ6GT*), *12-BH7A* (*12BH7*), *12L6GT* (*25L6GT*), *12BY7A* (*12BY7*), *12W6GT* (*6W6GT*), *19AU4* (*6AU4GT*), and *25CD6GA* (*25CD6G*). Tung-Sol Electric, Inc., Dept. ED, Newark 4, N. J.

CIRCLE ED-189 ON READER-SERVICE CARD

Name Plate

Flexible Yet Tough

Designed for use as a name plate, a laminated plastic called "Gravoflex" is flexible yet scratch-proof, weather-proof, and stain-proof. It can be bent by hand to any shape. Being a sandwich material, it is easily engraved with any pantograph machine. Lettering cut through the top layer will stand out permanently on a contrasting background.

The material can also be stamped or embossed. It can be cut with an ordinary scissor, paper cutter, or metal shears. Edges will not chip, and they do not require bevelling. It can be nailed without pre-drilling, and can also be stitched or stapled. Gravoflex is available in sheets, strips, or cut name plates in various thicknesses. The colors are black surface with white core, or white surface with a red core. Hermes Plastics, Inc., Dept. ED, 13-19 University Pl., New York 3, N. Y.

CIRCLE ED-190 ON READER-SERVICE CARD

CIRCLE ED-191 ON READER-SERVICE CARD ➤

New Products...

Piezoelectric Ceramic

Formed Into Any Shape

Designated "Ceramelex", this polycrystalline barium titanate ceramic performs in much the same manner as the natural piezoelectric crystals. It can be formed and polarized in any shape.

Polarized discs of this material have a very high coupling coefficient and are low-impedance devices because of their high dielectric constant. A "Ceramelex" Kit is available to design engineers. It contains 17 discs and cylinders of various sizes, with and without metal contacts, a research paper on the properties of the ceramic, and application notes. Erie Resistor Corp., Dept. ED, Erie, Pa.

CIRCLE ED-193 ON READER-SERVICE CARD

Insulating Compound

Protects Tool Handles

Featuring a dielectric strength per coating of 1200 to 1500v, "E-33", a dipping compound, is easily applied to tool handles. Available in either red or black, the compound can be used in the laboratory to coat electrical tools such as screwdrivers and pliers. The compound is chemically inert and is not affected by oils, greases, or ordinary acids or alkalis. Insl-X Sales Co., Dept. ED, 26 Rittenhouse Sq., Ardmore, Pa.

CIRCLE ED-194 ON READER-SERVICE CARD

Random Noise Generators

Noise Output is 15.8db

Additions to this firm's line of "Microwave Mega-Node" random noise generators employ new gas tubes. These tubes have approximately zero temperature coefficient and are independent of operating temperatures. Units with frequency ranges from 1200Mc to 26,500Mc are available. Accuracy is ±0.25db. Noise output is 15.8db. Kay Electric Co., Dept. ED, 14 Maple Ave., Pin Brook, N. J.

CIRCLE ED-195 ON READER-SERVICE CARD

CIRCLE ED-196 ON READER-SERVICE CARD ➤

Computing Service

Formulates and Solves Problems

A group of highly trained mathematicians offers a service featuring the mathematical formulation and complete solution of a problem from given physical data. Charts and nomographs of a high degree of complexity for the solution of electronic design problems can be prepared. Problems can be submitted for an estimate. Mathematical Computing Service, Dept. ED, 105 Court St., Brooklyn 2, N. Y.

CIRCLE ED-197 ON READER-SERVICE CARD

Power Transistor

Collector Dissipates 500mw

The Type HD-197 p-n-p germanium junction transistor is capable of 500mw collector dissipation without the use of a heat sink. Suitable for switching circuits, class B circuits, and servomechanisms, the unit has a base-to-collector current gain of 10.

Power gain, measured in a grounded-emitter circuit with an input impedance of 100 ohms and a load impedance of 5000 ohms, is 30db. Cutoff frequency is 150kc. Maximum operating temperature is 55°C. CBS-Hytron, Div., Columbia Broadcasting System, Dept. ED, Danvers, Mass.

CIRCLE ED-198 ON READER-SERVICE CARD

Cement

Has High Strength

Applied with moderate heat and little or no pressure, "Tygoweld", an organic cement, makes metal-to-glass, metal-to-porcelain, and metal-to-metal bonds that surpass high peel and shear tests. The bonds have been subjected to tensile strength tests where over 4000 lb/sq-in has been applied to standard lap shear specimens.

The following materials can be successfully bonded to themselves or to each other: aluminum, cast iron, copper, magnesium, sintered metals, ceramics, fiberglass, thermosetting plastics, wood, and nylon. It is furnished in rod, paste, or powder form with special colors and filleting characteristics available. U. S. Stoneware Co., Dept, ED, Akron 9, Ohio.

CIRCLE ED-199 ON READER-SERVICE CARD

◀ CIRCLE ED-196 ON READER-SERVICE CARD

New Products...

Rubber Coating

Vulcanizes Without Heat

Applied like paint by brush, spray, or dipping, "Rub-R-ize" is a liquid natural rubber that vulcanizes at normal temperatures into a flexible protective coating resistant to both heat and cold. It has the same insullation qualities as natural rubber.

The coating can be used to impregnate printed-circuit boards, insulate high-voltage cages, chassis, and antennas, protect components against humidity, and be used on phonograph turntables instead of flock. In the laboratory it can be used to repair frayed line cords, insulate tool handles, insulate the edges of work benches against grounding, and to coat leads instead of spaghetti. It can also be used as a sound absorbant material in bass reflex cabinets. Rubber Magic, Inc., Dept. ED, 4312 Third Ave., Brooklyn 32, N. Y.

CIRCLE ED-201 ON READER-SERVICE CARD

Photosensitive Metal Sheets

For Nameplates and Dial Faces

Photosensitive, anodized-aluminum sheets known as "Metalphoto" are designed for photographic reproduction by standard darkroom methods. The sheets can be used for nameplates, dial faces, wiring diagrams, instructions, instrument and sliderule scales, and other products where resistance to abrasion is vital.

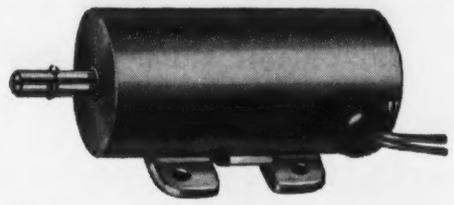
Photographs and drawings are processed from ordinary photographic negatives. The image or written matter is sealed behind the hard, anodized layer. This layer protects the dimensionally stable image from abrasion, temperatures up to 1000°F, as well as acids, salts, and organic solvents.

The sheets, which measure 0.020" in thickness, are furnished in 4" x 5", 8" x 10", and 10" x 12" sizes. The sheets may be colored with the proper dyes. Metalphoto Corp., 2903 East 79th St., Cleveland 3, Ohio.

CIRCLE ED-202 ON READER-SERVICE CARD

◀ CIRCLE ED-200 ON READER-SERVICE CARD

D-C Solenoids
Miniature Types



Type 20288 and 20287 solenoids are designed for applications requiring d-c solenoids considerably smaller than standard types. The former has a coil enclosed in a steel cylinder and the latter an open coil. They may be used for the operation of keyboards, light springs, control board signal flags, etc.

They measure 3/4" diam x about 1-1/2" length. Either may be wound for a wide range of d-c voltages. Their weights are 0.122 and 0.141 lb, respectively. The nylon bobbin is used as a bearing surface, thus providing self-lubrication as well as excellent insulation. Armatures are of high-grade soft iron.

An example of pull characteristics is the 24v, 13amp type which is operated on intermittant duty, 5sec max on time at 20°C ambient to pull 25 oz for a 3/4" stroke. Cannon Electric Co., Dept. ED, 418 West Ave. 33, Los Angeles 31, Calif.

CIRCLE ED-205 ON READER-SERVICE CARD FOR MORE INFORMATION

Tracing Carbon Paper
For Reproducing Drawings

Greater line opacity for engineering drawings, necessary for Bruning, Ozalid and similar process reproduction, is gained by use of this single-use tracing carbon paper. Yellow on one side and black on the other, it also produces a duplicate copy in black. Columbia Ribbon & Carbon Manufacturing Co., Dept. ED, Glen Cove, N. Y.

CIRCLE ED-206 ON READER-SERVICE CARD FOR MORE INFORMATION

Marker Generator
For All U-H-F TV Channels

The "Ultra-Marker" is an u-h-f marker generator with crystal controlled narrow-pip-type markers at picture and sound carrier frequencies of all u-h-f channels. By switching means, crystal controlled narrow-pip-type markers are provided on every fourth u-h-f channel starting with Channel 15.

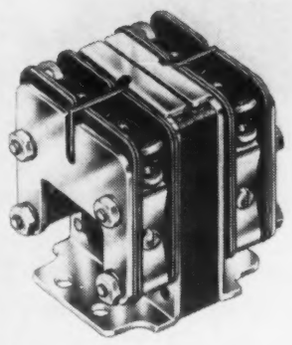
Maximum frequency error is 200kc, and mean percentage of error is 0.03% (percentage of error at center of band is 0.007%). Picture and sound carrier spacing is 4.5Mc ±0.01%. Input requirement is 10mv across 70 ohms from any sweeping oscillator covering the frequency range. Kay Electric Co., Dept. ED, 14 Maple Ave., Pine Brook, N. J.

CIRCLE ED-301 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Heavy Duty Relay

Meets MIL-R-5757B Spec.



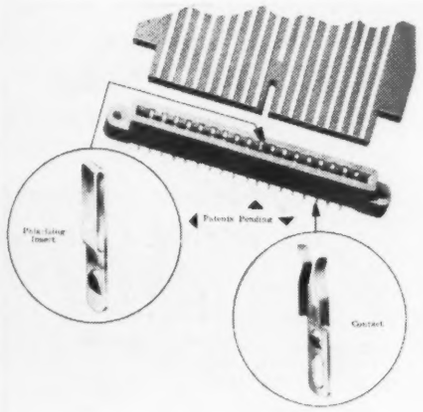
Designed to meet industrial requirements and comply with Specification MIL-R-5757B, the type RP 2pdt relay features a novel contact construction of high current carrying capacity. This construction and its linkage with the actuating mechanism make possible elimination of the usual flexible leads to the movable contacts.

The magnetic circuit is thoroughly laminated to reduce eddy current losses. The magnet winding is imbedded in a moisture-proof compound giving excellent resistance to ground. The electromagnet can be modified to operate the relay for up to 250v a-c or d-c interrupting a resistive load of 25amp 30v d-c or 110v a-c. At rated load the minimum life expectancy is 1,000,000 operations. The relay is available open or hermetically sealed. The Five Star Co., Inc., Dept. ED, West Main St., Plantsville, Conn.

CIRCLE ED-210 ON READER-SERVICE CARD FOR MORE INFORMATION

Printed Card Receptacles

Permit Easy Removal and Change



These printed card receptacles feature ease of removability and changeability by means of tongue pinching on contact. They have multi-wire connections to terminals, and afford dependable performance on repeated insertions over a range of card thickness from 0.061″ to 0.071″.

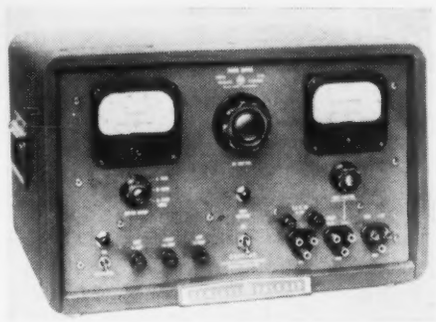
The contact or polarizing insert snaps into firm position on insertion into the molded body and is easily removed or its position changed by simply pinching the tongue and pushing out. Performance is assured by the high channel strength design of the contacts.

The insulating body is available in mineral-filled melamine, Alkyd 440 A, or Diallyl Phthalate. Contacts are spring phosphor bronze or beryllium copper, silver plated with gold flash. U.S. Components, Inc., Dept. ED, 454-462 East 148th St., New York 55, N. Y.

CIRCLE ED-211 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

Provides 0.01% Regulation



The Model 712B Power Supply is designed for heavy-duty laboratory or production work and is useful in powering temporary electronic circuitry, oscillators, small transmitters, complex experiments, and many types of klystrons.

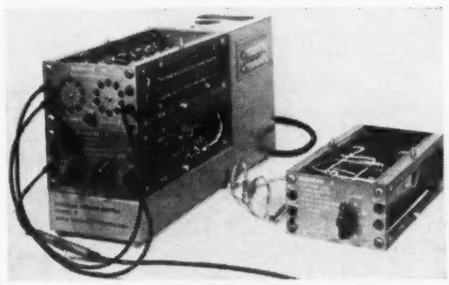
It provides 0.01% regulation for all conditions of load variation and power supply variation. In addition, it has extremely low internal impedance of 0.1 ohm in series with 25mh, a transient response of less than 1 millisec, and a hum voltage of less than 500mv.

The unit has four output options including a 0 to 500v, 200ma regulated supply; a fixed —300 regulated supply which may be in series with the 500v supply providing a 50ma, 500v to 800v variable supply for klystron tube operation; a 6.3v, 10amp a-c unregulated supply; and a continuously variable regulated bias voltage from 0 to 150v. There is less than 50mv change in the regulated supplies from no load to full load and for ±10% line variation. Other features include separate voltage and current meters and generous overload protection. Hewlett-Packard Co., Dept. P-ED, 395 Page Mill Rd., Palo Alto, Calif.

CIRCLE ED-214 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

For Use in Modular Systems



The Model 2 Modular Power Supply is especially designed for use with this firm's Modular System of electronic units. It provides power to operate three or more modular units, depending on those used. It aids in the quick assembly of special function devices and in the design and construction of electronic equipment. Modular units are mechanically locked together, interconnected by special patchcords, and the electronic function desired from each unit is selected by a multi-position switch.

The new power unit is only 15" long x 4-3/4" wide x 7-1/2" high, with a weight of 11 lb. It has an output of 80ma, +300 v d-c; 15ma, —150v d-c; and 8amp, 6.3v a-c. It is connected to units by standard Modular power plugs. Audio Products Corp., Dept. ED, 2265 Westwood Blvd., Los Angeles 64, Calif.

CIRCLE ED-215 ON READER SERVICE CARD FOR MORE INFORMATION

New Products...

Relay

For Crowded Chassis

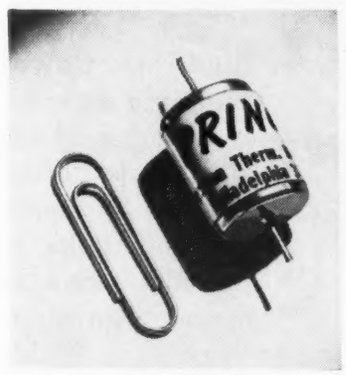
This sensitive relay is designed primarily for use in electronic chassis which have sufficient height but little adjacent space.

The unit provides a hermetically sealed dpdt combination, and has a capacity up to 3amp inductive load. It is equipped with a standard octal socket. Wattage consumption is 0.1w and less, depending on the contact arrangement, or less than 1ma, depending on the voltage used. Coil resistances can be furnished up to 30,000 ohms. D-c relays have a drop-out approximately 80% of the pick-up. Hedin Tele-Technical Corp., Dept. ED, 640 W. Mt. Pleasant Ave., Livingston, N. J.

CIRCLE ED-234 ON READER-SERVICE CARD

Varistor Unit

Eliminates Thermostat Arcing



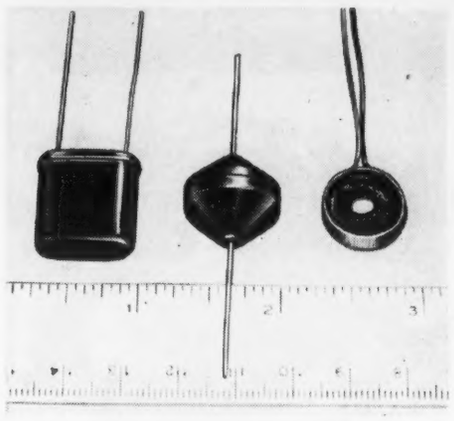
Arcing, the main cause of contact failure in mercury-in-glass thermostats, can be eliminated by the use of the "Stat-Varistor". Normally, arcing occurs when the thermostat circuit opens. At this moment the magnetic energy stored in the relay changes quickly to surging electrical energy that unloads through the unit.

All of this firm's thermostats can now be provided complete with the "Stat-Varistor". In addition, the device is available as a separate unit for use on existing installations or as a component for other new relays. Precision Thermometer & Instrument Co., Dept. ED, 1434 Brandywine St., Philadelphia 30, Pa.

CIRCLE ED-235 ON READER-SERVICE CARD

Subminiature Toroids

Packaged for MIL-T-27



These subminiature toroids are available in three lines. They are designed for: use in the 1kc to 1Mc range, with Q's of 100-200, at a tolerance ±1%, with high stability over the temperature range of —55° to +85°C, and inductances from 4μh to 1h.

The QL050 Series are wax impregnated with flexible high temperature leads. Size: 5/8" OD x 1/8" ID x 9/32" high.

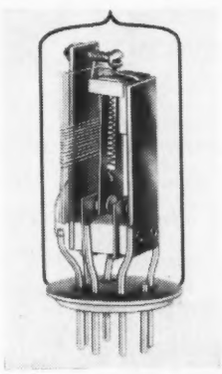
MP050 Series are molded plastic units with axial wire leads suitable for point-to-point wiring, or terminal board mounting.

The HS050 Series are hermetically sealed metal cans with wire leads. They can be wired in subminiature sockets or soldered to printed circuit boards. They will withstand tests of MIL-2-27, Class A, Grade 1. Case dimensions: 5/16" x 11/16" x 49/64" high. Communication Accessories Co., Dept. ED, Hickman Mills, Mo.

CIRCLE ED-236 ON READER-SERVICE CARD

Thermal Time Delay Relay

In Variety of Ratings



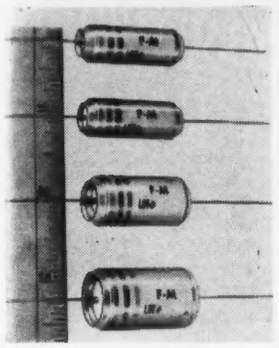
"Snapper" thermal relays feature "snap action" of contacts in an inert gas-filled atmosphere. Units are spdt and are available in 7- or 9-pin miniature or octal metal envelopes.

Designed for ambient temperature operation ranges of —60° to +80°C, the relays operate on 6.3v, 26.5v, 115v, a-c or d-c, or as required. Time delay is from 2sec and up. The units withstand vibration of 30g at frequencies of 5 to 55cy. Elly Electronics Corp., Dept. ED, P.O. Box No. 395, Fairlawn, N. J.

CIRCLE ED-237 ON READER-SERVICE CARD

Hermetically Sealed Coils

From Stock or Custom-made



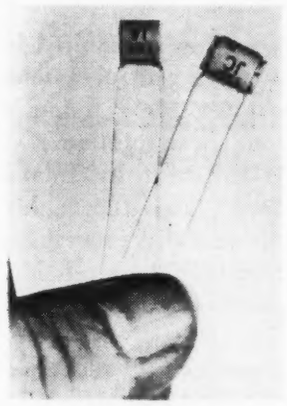
This series of hermetically sealed coils for electronic applications is offered in a wide range of electrical and mechanical characteristics. Features include: hermetic sealing to provide absolute protection against the effects of moisture; true glass-to-metal sealing technique; an insulated metal case; and specifications exceeding the most rigid requirements.

One typical unit has an inductance of 20mh, current rating of 120ma, and dimensions of 0.735″ diam x 1-1/16″ long. Another coil has an inductance of 4.7μh, current rating of 600ma, and dimensions of 0.450″ diam x 1-1/16″ long. In addition to a standard line, hermetically-sealed coils can be produced in types and sizes to customer specifications. Fugle-Miller Laboratories, Dept. ED, 398 Main St., Metuchen, N. J.

CIRCLE ED-238 ON READER-SERVICE CARD

Resistors

High Reliability Sub-miniatures



Subminiature Type J Precision Wire-Wound Resistors, designed for top reliability and performance in spite of small dimensions, employ an improved method of terminating the winding to the wire leads.

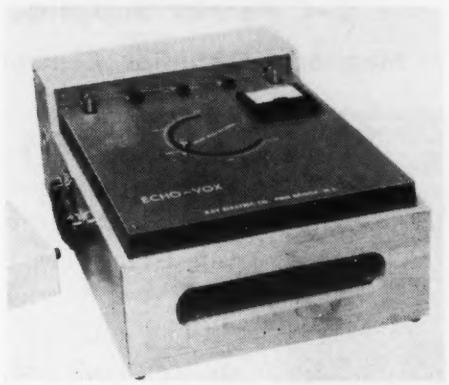
Type JA is 1/4″ diam x 1/4″ long. Maximum resistance is 125,000 ohms. Military power rating is 0.1w. Type JG is 1/4″ diam x 3/8″ long. Maximum resistance is 250,000 ohms. Power rating is 0.15w. Tolerance of 1% is standard, with 0.05% also available.

The resistors have a mounting hole for a No. 2 machine screw. Leads are of heavily tinned copper wire. All resistors are furnished with low temperature coefficient alloys unless otherwise specified. Special wire and impregnation is available for increased power rating. Resistance Products Co., Dept. ED, 714 Race St., Harrisburg, Pa.

CIRCLE ED-240 ON READER-SERVICE CARD

Variable Time Delay

Used at Audio Frequencies



The "Echo-Vox" is designed to provide a wide and continuously variable time delay at audio frequencies. One application is for the proper phasing of speakers in large areas where objectionable echoes exist.

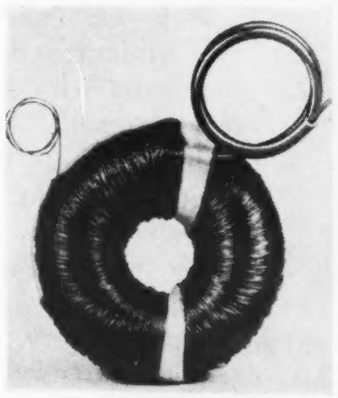
Specifications are: frequency response, 40cy to 12,000cy; flutter, less than 0.3%; harmonic distortion, 2% maximum; intermodulation distortion, 5% maximum; input impedance, 600 ohms; output impedance, choice of 600 ohms, 8 ohms, and 3.4 ohms; output power, 25w max. for speaker drive.

Single echo time delay is continuously variable from 100-500 millisec. There is an adjustable feedback for multiple reverberation. Power input is 115v 60cy, 160w. Dimensions of the carrying case are 9-1/4″ x 15″ x 20″. Weight is 54lbs. Kay Electric Co., Dept. ED, Pine Brook, N. J.

CIRCLE ED-241 ON READER-SERVICE CARD

Toroid Coils

Provide Adjustable Inductance



Adjustable toroid coils which provide a simple method for varying inductance are announced by the company. Coils are factory adjusted to within ±5% of nominal inductance values and are economically priced due to the elimination of critical adjustment and impregnation.

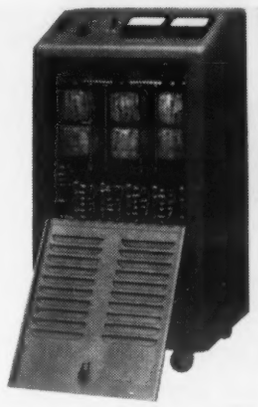
Especially useful in resonant L-C circuits, these units are available with maximum Q factors from 120 to 200. Sizes range from 1″ OD x 3/8″ to 2-1/4″ OD x 1″. Hycor Sales Co. of Calif., Dept. ED, 11423 Vanowen St., North Hollywood, Calif.

CIRCLE ED-242 ON READER-SERVICE CARD

New Products . . .

D-C Power Supplies

Magnetic Amplifier Controlled



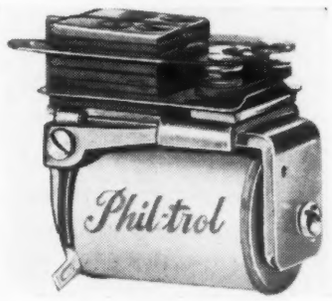
These magnetic-amplifier-controlled d-c power supplies contain neither moving parts nor tubes, and require no warm-up time. They are constructed to withstand rough operating conditions and their life is rated in terms of years of maintenance-free operation. They have been successfully used in various applications, such as servomechanisms, bias supplies, reference supplies, filament power supplies, battery chargers, computer power supplies, and heavy-duty regulated sources of d-c power.

Typical specifications include: voltage regulation, ±1% from no-load to full load for ±10% change in line voltage; response time, 0.2sec or less; ripple voltage, 1% rms of nominal d-c output voltage; controls, one variable potentiometer for d-c output voltage range adjustment; line voltage, 115v, single-phase, 208/230/440v, three phase; d-c output voltage range, 28.5v nominal, 22-30v d-c; d-c output currents available, 5, 10, 50, 100, 200, 500amps. Mag-Electric Products, Inc., Dept. ED, 12822 Yukon Ave., Hawthorne, Calif.

CIRCLE ED-219 ON READER SERVICE CARD FOR MORE INFORMATION

Power Relays

Miniature D-C Units



Series 4B Power Relays are miniature d-c power contactors with high current contacts. They are small in size (1-23/32" length) and light in weight (3 oz. approx.), with the added feature of having the capacity to handle large currents through the contacts.

The relay's large coil capacity permits high-contact pressure and large contact gap with minimum power consumption in the coil. Operating voltage is up to 200v d-c. Maximum coil resistance is 16,000 ohms. The relays are available single or double wound.

The contact assembly is rated 20amps, 125v, continuous; 60amps, 280v inrush. Standard contacts are 1/4" silver contacts. Other contacts are available for special applications. The design is double make only. Phillips Control Corp., Dept. ED, 84 W. Jefferson St., Joliet, Ill.

CIRCLE ED-220 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature . . .

Microwave Test Equipment 223

This firm's first catalog covers its full line of precision microwave test equipment, which includes all the required units and components for operation in the microwave region. The company also has a custom engineered and built line of antenna pattern analyzers, high power pulse modulators, and waveguide components for test and production applications. The catalog is well illustrated and firmly bound in multi-ring leatherette binders. Electronics and X-Ray Div., F-R Machine Works, Inc., 44-14 Astoria Blvd., Long Island City 3, N. Y.

Improved Tube 224

An 8-page booklet (No. ETD-881) describes the new *GL-2C39-BB* metal and ceramic "Lighthouse" tube, an improved version of a similar metal and glass tube. The new high-mu triode is designed for use in v-h-f—u-h-f circuits as a grounded-grid class C power amplifier, oscillator, or frequency-multiplier, at frequencies up to 2500Mc. Technical data and typical operating conditions are included. General Electric Tube Dept., Schenectady 5, N. Y.

Metal Stampings 225

"Trims, Panels and Escutcheons" is the title of a 4-page booklet that illustrates the use of decorated metal stampings as functional component parts. It shows many examples of modern planning that reduce original tool costs by using stock dies in numerous cases. Samples shown cover a wide range of end product uses which vary from locomotives to table model radios. Piece size variation is from less than 1 sq″ to a stove panel 37″ x 8″ wide. American Name Plate & Mfg., Co., 4254 West Arlington St., Chicago 24, Ill.

Transformer Laminations 226

Two new catalog pages on 1-3/4″ E and I transformer laminations are now available from this company. Complete technical data is listed including dimensional drawings, stacking factor, specifications, weight and count. Type T-175 RH features the new RETMA corner mounting holes and Type T-175 H has standard mounting holes. Temple Manufacturing Co., Bryn Mawr at Damen, Chicago 26, Ill.

Training Method 227

An improved plan for training and testing proficiency of personnel to service electronic equipment is described in a 46-page illustrated folder. The method is covered in detail, and might be valuable for training assistants for electronic designers. Van Valkenburgh, Nooger & Neville, Inc., 15 Maiden Lane, New York 7, N. Y.

Indicating Instruments 228

A 48-page catalog covers various indicating instruments, laboratory portables, and panel meters of finer accuracy. It provides illustrations and specifications of the more popular sizes of round, square, flush, semi-flush, switchboard, horizontal, edgewise, and fan type meters, as well as 250° arc-sealed and ruggedized types presently available. Hickok Electrical Instrument Co., 10525 Dupont Ave., Cleveland 8, Ohio.

Casting Resins 229

Potting and casting resins for high and low temperature applications are covered in this 16-page booklet. It presents technical data on a number of "Airtemp" resins which are of the epoxy type. Aries Laboratories, Inc., 270 Park Ave., New York 17, N. Y.

New Literature . . .

Component Catalog 247

A very wide variety of products for the electronics industry is listed in this 30-page catalog (No. C-1154). Foundation chassis, chassis parts, plugs, tools, sockets, switches, tube shields, coils, terminals, hardware, and hundreds of other components are illustrated and described. Insuline Corporation of America, 36-02 35th Ave., Long Island City 1, N. Y.

Time-Delay Relays 248

This bulletin (No. TD400) discusses the Series 6400, 11400, and 23300 miniature, hermetically sealed time delay relays. Delay settings from 2 sec to 3 hr for either a-c or d-c units are available. The relays are furnished in one-, two-, or three-switch units. Mounting is by flange or stud. A. W. Haydon Co., 230 N. Elm St., Waterbury, Conn.

Instrument Generator 249

A permanent magnet, continuous duty generator recommended as a precision voltage source is described in this leaflet, Form GPM-44A. The brochure illustrates the unit, provides dimensioned outlines, and tabulates physical and electrical characteristics. Operating parameters of phase voltage vs load-per-phase are presented graphically for operating speeds of 1200, 2100, and 4500 rpm, giving frequencies of 20, 35, and 75cy. It weighs 9 oz. Dalmotor Co., 1326 Clay Street, Santa Clara, Calif.

Pressure Transducers 250

Bulletin No. PT-1 (12 pages) describes instruments for the measurement of gage differential, and absolute pressures. The transducers are based on the principle of the firm's unbonded strain gage which translates pressure into an exact electrical analog output by means of a complete balanced bridge of strain-sensitive resistance wire. The bulletin includes drawings, specifications, and selection tables for eight designs for pressure measurements from 0-0.05 to 0-10,000psi. Statham Laboratories, Inc., 12401 West Olympic Blvd., Los Angeles 64, Calif.

Clutches 251

Catalog No. B-54 depicts a line of miniature, one-way-roller clutches that permit drive in one direction with free-wheeling action in the opposite direction. Design and installation data and dimensions are given for roller assemblies as well as complete clutches. Typical applications for one-, two-, and three-clutch assemblies, with photographs and drawings, are included. Miniclutch Co., 379 Morse St., Hamden, Conn.

R-F Filters 252

A complete line of r-f filters, low-pass, high-pass, band-pass, band-rejection, and complementary, is described with characteristics in this 4-page, bound bulletin. Actual-size photographs of typical response curves illustrate what can be done in extremely compact units to give maximum attenuation over the desired stop band with minimum insertion loss and VSWR over the pass band. Balco Research Laboratories, 49-53 Edison Pl., Newark 2, N. J.

Vibration Isolation 253

How to stop vibration and shock, reduce noise, and cut down on the wear and tear of industrial machinery is the subject of this booklet, designated No. 850. It describes a new concept of vibration and shock control based on the employment of resilient, primary load-carrying cushions of knitted metal wire. Examples of typical industrial mounts and mounting systems are illustrated and engineering data given. Applications range from delicate precision equipment to massive machinery. Robinson Aviation, Inc., Teterboro, N. J.

Hand Tachometers 254

This manufacturer's Bulletin No. 103 describes a series of new three-in-one hand tachometers which dependably measure the speeds of rotating parts and moving surfaces. Incorporating three separate ranges in one instrument, only one range appears at a time, thereby minimizing reading errors. Ranges are selected by flipping a switch, and there is no fear of damage due to over-speeding or selection of the wrong range. Metron Instrument Co., 432 Lincoln Street, Denver 3, Colo.

Plastic 255

A reinforced alkyd plastic known as "Plaskon" is described in this bulletin with all its advantages for the electronics industry listed. It is reinforced with glass fibers. Barrett Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.

Test Chamber 256

A temperature test chamber with a range from −65°F to +350°F is described in this 4-page bulletin. The test chamber is 7″ x 15″ x 7-1/2″ deep. Statham Development Corp., 12411 West Olympic Blvd., Los Angeles 64, Calif.

Metal Processor 257

A description of the services of a processor of common, precious, and little-used metals and alloys into wire, ribbon, and foil is given in this 4-page bulletin. Such metals as indium, tellurium, palladium, etc. are extruded into wires used extensively as precision resistance elements. Baker & Co., Inc., 113 Astor St., Newark 5, N. J.

Environmental Testing 258

Tests for vibration, shock, acceleration, high and low temperature shock, humidity, high altitude and explosion, salt spray, sand and dust are covered in this 4-page illustrated folder. Some of the environmental equipment used in making the tests is also illustrated and described, the more common types of equipment being listed for quick reference. A brief review of other fields of testing specialized in this organization is also included. New York Testing Laboratories, Inc., 47 West St., New York 6, N. Y.

D-C Indicating Amplifier 259

A new design approach, the highly stable performance, and the unique principle of operation of this firm's Type 2HLA-3 D-C Indicating Amplifier are described in this engineering bulletin. It should be of particular interest to engineers in fields of automation, process control, and instrumentation. The bulletin (No. 1A) also includes a photographic illustration, detailed description, typical applications, and a discussion of the principle of operation. Doelcam Corp., 1400 Soldiers Field Road, Boston 35, Mass.

Co-axial Components 260

Various type connectors, adapters and waveguides for co-axial applications are described and illustrated in this 16-page catalog. An index by military types is also included. Electro Precision Products, Inc., 139-30 34th Road, Flushing, N.Y.

Galvanizing 261

A method of galvanizing ferrous metals by brushing or spraying a fluid known as "Galvicon" on the surface at room temperatures is described in a 10-page booklet. It leaves a coating of 96 parts, by weight, of zinc. The coating dries in 48 hr. Galvicon Corp., 40 W. 29th St., New York 1, N. Y.

Germanium Diodes 262

A complete crystal diode replacement chart is included in this 4-page bulletin (No. GD-1A), which lists ratings and specifications on this firm's line of germanium diodes. Included are the "Red Dot" line of diodes for 100°C applications. International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

Vibration Isolation 306

"Shock and Vibration Control Notes" is the title of this company's new technical house organ, the first of its kind devoted exclusively to shock, vibration, and noise isolation. Published quarterly, it is intended to provide a medium for the collection and propagation of ideas and information in the shock and vibration isolation fields. It will contain material dealing with specific technical problems and reports based on continous research in these fields, as well as articles based on problems sent in by engineers, the solutions of which would be of interest to industry. The Barry Corp., 718 Pleasant St., Watertown 72, Mass.

Flexible Ducting 307

A 4-page illustrated brochure describes "Flexflyte", one of this company's new forms of flexible ducting. It covers the various types of Flexflyte, its method of manufacture, standard coatings and diameters available, and method of installation. Complete engineering and data sheets are provided with the booklet. Flexible Tubing Corp., Guilford, Conn.

New Literature . . .

Wire Thread Inserts 264

Designers concerned with fastening and mounting and other users of wire thread inserts will be interested in this new 4-page bulletin (No. 708). By presenting all basic information on the manufacturer's wire thread inserts and tools in condensed form, it saves time in designing, specifying, and ordering inserts. Illustrations and tables present data and installation instructions on inserts and tools for National Course and Fine, Unified Course and Fine, Spark Plug, and Pipe Thread Series. Heli-Coil Corp., Danbury, Conn.

Catalog Index 265

Bulletin 100-C lists all current literature available from this company. Numbers and titles of all catalogs, bulletins, specification sheets, and instrumentation data sheets are included. Minneapolis-Honeywell Regulator Co., Industrial Division, Wayne and Windrim Aves., Philadelphia 44, Pa.

Actuator Motor 266

A series-wound 25w miniature motor designed for use as a driving element in low or high-speed linear or rotary-actuator applications is described in a new leaflet, Form SR-43. One of a series, the leaflet provides all primary data required for the design engineer. The motor is illustrated, detailed in dimensioned outline drawings, and defined in a listing of electrical and physical characteristics. Performance data, given in graphic form, covers rpm, efficiency, output watts, and input amperes over the torque output range to 4.25 oz in. Dalmotor Co., 1326 Clay St., Santa Clara, Calif.

Air Data Computer 273

An 8-page technical brochure gives information on the company's Master Air Data Computer which provides a single coordinated source of information and eliminates much duplication. Schematic diagrams show how the plug-in type computer permits calculation of complex functions with a minimum of equipment. Servomechanisms, Inc., Post and Stewart Aves., Westbury, L. I., N. Y.

Inductor Curves 269

A set of characteristic curves for the firm's "Vari-L" electrically variable inductors has been made available in the form of a series of data sheets. The units are high frequency saturable core reactors designed to control the resonant frequency of a tuned circuit as a function of a d-c or a-c current. The curves show the control characteristics of a number of typical units. Vari-L Company, Inc., P. O. Box 1433, Stamford, Conn.

Hardware 270

A folder gives a quick view in illustrations and text of all the products the company makes for the electronics industry. Included are socket head cap screws and shoulder screws, socket set screws, button head and flat head socket screws and dowel pins, "Flexloc" self-locking nuts, "Hallowell" steel collars, and "Sel-lok" spring pins. The folder, entitled "One Source of Supply For Your Fastener Requirements", lists the sizes of all the products, their materials, and the plating they are available in. Standard Pressed Steel Co., Jenkintown, Pa.

Sintered Metals 271

This bulletin (No. 1) provides an introduction to the art of powder metallurgy. It describes the general types of metal powder offered by the company, and stresses the large number of grades required for different applications. Also included in the pamphlet are references to some of the other major uses for metal powders such as the fabrication of special electronic and magnetic parts. Among the metals available in powdered form are steel, nickel, manganese and silicon. Plastic Metals Division, National Radiator Co., Johnstown, Pa.

TV Tube Types 272

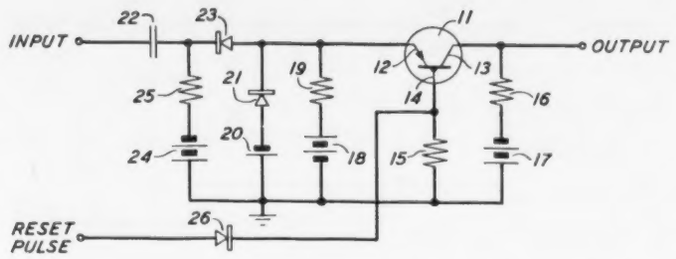
A 12-page booklet (No. ETR-886) lists recommended receiving and cathode ray tube types for AM, FM, and TV receivers. These are compiled in tabular form to cover essentially every requirement of the radio and television manufacturer. Included are characteristics reference charts on the tube types listed, and interpretation of technical data. General Electric Tube Dept., Schenectady 5, N. Y.

Patents . . .

Regenerative Transistor Amplifier . . . *Patent No. 2,670,445. Jean H. Felker. (Assigned to Bell Telephone Laboratories.)*

The transistor circuit shown in Fig. 1 is a regenerative pulse amplifier that is useful in high-speed switching systems common in computers. In these systems low-level pulse signals are amplified and reshaped. Basically, the circuit is a flip-flop circuit having low and high current states. The input signal triggers the circuit from the low current state to the high current state. Either a p-type or an n-type transistor may be used with reversal of the battery and rectifier polarities. The circuit given calls for an n-type unit.

The circuit parameters are chosen so that the circuit operates in that region of transistor characteristic curve, as shown in Fig. 1, where the curve of emitter voltage versus current reaches a peak at or about zero emitter current and then the curve slopes off to a valley after which the curve again slopes upwardly. The potentials of battery *18*, 12v, and battery *20*, 1v, are also selected so that the respective load lines of resistor *19* and crystal diode *21* intersect at a point slightly displaced from but adjacent to the peak in the emitter characteristic curve. Battery *20* also serves to return the emitter to a small negative voltage. The junction of crystal diode *23* and coupling condenser *22* is maintained negative by battery *24*, which delivers 8v. Crystal diode *23* serves to isolate



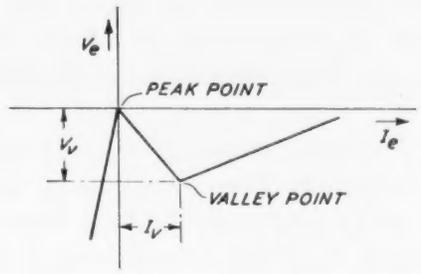


Fig. 1. A flip-flop transistor circuit that functions as a pulse amplifier and an explanatory characteristic curve.

the flip-flop circuit for the transistor from the preceding circuit.

Resistor *19*, 24,000 ohms, and resistor *25*, 3900 ohms, are selected so that when no emitter current flows the transistor rests at a voltage just below the peak of the characteristic curve or below the bias on diode *21*. An input pulse raises the voltage above the peak point and diodes *21* and *23* are cut off. Positive emitter current then flows, which causes the emitter voltage to fall to the valley point of the characteristic curve and snap out to a high current point on the upward slope of the characteristic curve, where it remains indefinitely. The transistor circuit may be restored to its initial condition by applying a reset pulse to the base (*14*) of the transistor. By using timed reset pulses or signals, the very rigid synchronism required in computer circuits is secured in a simple manner and the duration of the pulse is controlled by the timing signal independently of the input signal.

Patents . . .

Antenna . . . *Patent No. 2,671,855. Lester C. Van Atta, Winchester, Mass. (Assigned to the United States.)*

In microwave antenna systems for the radiation or reception of short waves of the order of centimeters in length, it has been known that there is a reflection of energy from the reflector back into the feed or transmission line. By using matching transformers, this reflection of energy back into the feed line has been kept at a level where it is not troublesome for the frequency at which the system is designed to operate. If, however, there should be a slight change of operating frequency such as may well occur by a change in the transmitter tube, the present methods of keeping to a minimum the energy reflected back into the line do not function as well as desired because the components used as well as the antenna itself are frequency sensitive or lack broadband characteristics.

The antenna system illustrated in Fig. 2 has broadband characteristics gained by

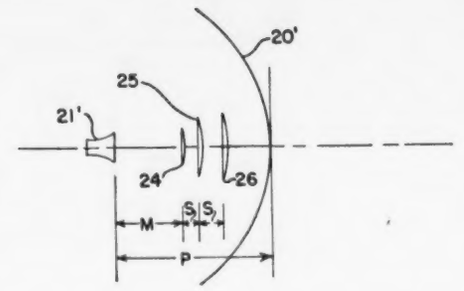


Fig. 2. Microwave antenna system.

placing one or more matching or compensating reflectors (*24, 25,* and *26*) of small size on the axis of the reflector *20'* and between the antenna *21'* and the reflector. Its location should be approximately one eighth of a wave length in front of reflector, although in order to reduce the incidence of side lobes and a loss of antenna gain the compensating reflector may be located an even number of half waves from the position illustrated.

In a location farther removed from the reflector the matching reflector may be smaller. The compensating reflector has a size which has the effect of compensating or canceling out the energy reflected back

into the feed line from the reflector *20*, but should be small enough not to interfere with the directive function of the system. The optimum location and size of the matching reflector may be determined by test. The compensating reflector may have practically any desired shape. With more than one matching reflector, more effective broadband characteristics will be secured.

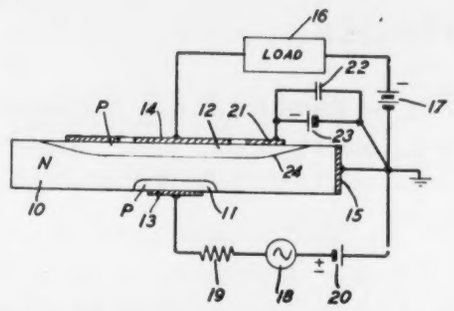


Fig. 3. Tapered P-type zone transistor.

Semiconductor Translating Device . . . *Patent No. 2,672,523. William Shockley. (Assigned to Bell Telephone Laboratories.)*

A transistor of the kind in which the body is of one type and a zone thereof is of the other type experiences a direct current bias of substantial proportions during operation between the P and N portions of the device at the collector. A P-type region may be made in an N-type body in various ways such as by nuclear bombardment of the surface. A transition region (*24*, Fig. 3) between the two type regions intersects the surface, and because of the potential difference between collector *12* and the body (*10*), there is a strong field present and leakage currents do occur. These cause noise in the output circuit.

A reduction in the field may be achieved by tapering the P-type zone near its margin. Other ways of tapering the zone are described in addition to the method illustrated. The leakage current can be further reduced by supplying an auxiliary electrode (*21*) surrounding collector *14* in the vicinity of the intersection. A condenser (*22*) between this electrode and the base (*13*) assures that it is at alternating current ground potential. A potential source (*23*) may bias the auxiliary electrode at a potential intermediate between that of the collector and base.

Patents . . .

Method of Manufacturing A Conductive Coated Sheet and Said Sheet . . . (*Patent No. 2,680,699*) *Milton D. Rubin, Rochester, Mass.*

Of primary importance in printed circuitry, a process for securing an adhering metallic coating upon an insulating plate is set forth in the patent. The process starts with a paper material that has a metallic film evaporated on one surface. A metallic coating is then plated on the film, and the sheet is thoroughly cleaned. The unplated side of the paper sheet is then impregnated with a thermosetting resin that is only partially cured. A thermosetting base sheet is then applied under pressure to the partially cured impregnated surface, and the latter is then fully cured. With this method, a strong bond is secured between the metallic conductive coating and the insulating material (Fig. 4).

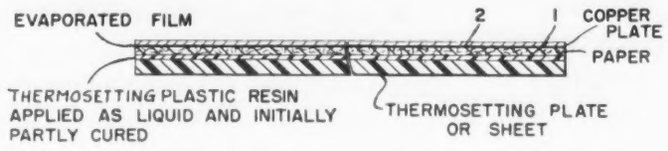


Fig. 4. Cross-section of the printed-circuit laminate.

AEC Patents For Industry

Additional patents owned by the Atomic Energy Commission have been made available for licensing. Licenses will be granted to applicants on a non-exclusive, royalty-free basis. Applicants should apply to the Chief, Patent Branch, Office of the General Counsel, U.S. Atomic Energy Commission, Washington 25, D. C., identifying the subject matter by patent number and title. Of the 25 patents released, the following ones are particularly interesting to electronic design and development engineers.

Coincidence Circuit (*Patent No.* 2,677,759); ***R. Madey, inventor.*** The patent relates to an improved fast coincidence circuit which is highly

discriminatory with respect to single pulses. The coincidence circuit is designed so that it will reject single pulses and only pass a pulse to the output when coincidence pulses having a selected magnitude occur.

Linear Cathode (Patent No. 2,677,778); *W. R. Baker and D. A. Vance, inventors.* The patent pertains to an improved dispenser type thermionic cathode which is rugged, efficient, simple and easily disassembled.

Mechanical Register (Patent No. 2,678,773); *W. E. Glenn, Jr., inventor.* The patent pertains to a counting device having a magnetic rotor disposed between the poles of one magnet in cooperating relation with another magnet and indicating means for determining the angular disposition of the rotor. The low friction and low-inertia mechanism overcomes many of the disadvantages of existing mechanical registers.

Protective Circuit (Patent No. 2,680,212); *P. E. Frazier, inventor.* The patent relates to a protective circuit adapted for cooperation with a parallel-connected ignitron for recording various types of operating faults and for de-energizing the tubes upon the occurrence of operating faults of predetermined seriousness.

Electronic Controlled Pumping System (Patent No. 2,682,364); D. S. Schover, inventor. The patent describes an electronically controlled gas pumping system of the toepler type. Electronic means are provided for alternately evacuating and applying pressure to the fluid pumping apparatus.

Variable Voltage Wave Form Generator (Patent No. 2,683,807); G. D. Paxson, inventor. The patent relates to an electronic circuit for generating a voltage waveform having a plurality of variable voltage points which may be varied independently without disturbing the value of the voltage at other points of adjustment of the waveform.

Ion Beam Measuring Device (Patent No. 2,683,814); R. L. Mather, inventor. The patent covers an ion beam energy measuring device and particularly to determining the angle of emission of secondary radiation generated by the bombarding beam. The angle of emission of the secondary radiation generated is a function of the energy of the bombarding beam, which may be determined thereby.

Shock or Vibration Isolating Means (Patent No. 2,684,825); E. K. Arnold, D. W. Laviana, and G. L. Cooper. The patent relates generally to means for isolating objects from shocks or vibration. The apparatus comprises a combination of steel springs and variable rate silicone springs in parallel to achieve isolation and protection at extreme high and low temperatures and regardless of the positioning or attitude of the moving system.

Resonant Type Shake Table (Patent No. 2,686,427); D. M. Ellett and W. E. Baker inventors. The patent covers an adjustable-frequency shake table capable of large excursions with small input energies. The table is caused to move to vibrate, by an electromagnetic motor, the energization of which is adjustable in frequency.

Books . . .

Form In Engineering Design . . . *By J. Beresford-Evans, 96 pages, Oxford University Press, 114 Fifth Ave., New York 11, N. Y. $1.70.*

Written for the engineer and not the artist or industrial designer, this book is based on the assumption that anyone has the ability to recognize good form. This assumption is followed to two conclusions: good appearance means good sales, and engineers can be trained to design products with pleasing appearances. Not simply a how-to-do-it handbook, the volume considers how a designer functions and what design is as a concept.

Beginning logically with the total form, which the writer holds is closely related to function, the work progresses to important details such as meters, handles, knobs, and finishes. The author makes the worthwhile point that a knob should indicate by its shape how it is manipulated. In other words, an on-off switch should not have a round knob, which indicates continuous rotation. The proper lettering for meter faces is also discussed.

The final chapter, entitled "Presentation", tells how to present a sketch in the manner most likely to enhance it and thereby gain approval from management. There are three appendices. The first is a bibliography with one-paragraph abstracts for each work listed. The second discusses perspective, and the third recommends various water-color washes to be used on sketches submitted for approval. Each chapter is well illustrated with drawings, and a group of photographs of outstanding technical designs is bound in the book.

A Survey of Automatic Digital Computers, 1953 . . . *109 pages, paper cover. Prepared by the Office of Naval Research. Available from U. S. Department of Commerce, Office of Technical Services, Washington 25, D. C. $2.00.*

Electronic design laboratories requiring the services of a digital computer will find this publication of great value. It is the result of the latest world-wide O.N.R. survey of digital computers in operation. The first such survey was undertaken in 1947. Ninety-eight different types of computers in the United States and 11 foreign countries are listed on separate pages with all pertinent data such as their capacity, speed, and availability. An alphabetical index of the computers by name and a listing of the computers and their builders by the state or nation they are located in are also given.

Acoustics . . . *By Leo L. Beranek, 481 pages. McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. $9.00.*

Based on the author's experience in teaching at the Massachusetts Institute of Technology and designed as a textbook, this well-illustrated volume should serve as a valuable introduction to or reference on acoustics for many electronic designers. Beginning with a discussion of the terminology in the field, the author devotes many pages to the wave equation, considers all types of sound producing and receiving equipment, and ends with a chapter on hearing, speech intelligibility, and psychoacoustic criteria.

The last chapter is of value to engineers seeking to determine the minimum frequency band or maximum noise level permissible to still convey speech or intelligibility. There is also a chapter on acoustic measurements. This work should help to secure the position of acoustics as a precise science.

Television Factbook . . . *400 pages, paper cover. Television Digest, Wyatt Building, Washington 5, D. C. $4.00.*

Designers of equipment for the television industry will find the *Television Factbook*, of which this is the 19th semi-annual edition, of interest. All the TV stations in the United States and 110 stations in 32 foreign countries are listed together with many other industry statistics. The text of the FCC color standards is given.

Advertising Index

September 1954

ELECTRONIC design

HAYDEN PUBLISHING COMPANY, INC.
127 East 55th Street, New York 22, N. Y.

Postmaster: Form 3547 Requested